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Due to the high demand historically placed on engineers by an amphibious landing force after it has deployed ashore, how Australian Army Engineers fit into Australia's Amphibious Concept must be established in order for the Australian Defence Force to successfully execute amphibious operations, prior to any future such commitment.

As the list of engineering tasks required to support the full spectrum of operations in the current and future operating environments is quite extensive, an ad hoc engineer group to support the Landing Force cannot simply be formed, nor is there a one-size-fits-all engineer solution. If Australia is to have a serious amphibious capability, the Australian Government and the Australian Defence Force must invest time, effort, and money to ensure that the Australian Army is capable of conducting engineering from the sea.

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MASTER OF MILITARY STUDIES

ENGINEERING FROM THE SEA: ESTABLISHING HOW AUSTRALIAN ARMY ENGINEERS FIT INTO *AUSTRALIA'S AMPHIBIOUS CONCEPT*

SUBMITTED IN PARTIAL FULFILLMENT
OF THE REQUIREMENTS FOR THE DEGREE OF
MASTER OF MILITARY STUDIES

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Executive Summary

Title: Engineering from the Sea: Establishing how Australian Army Engineers fit into *Australia's Amphibious Concept.*

Author: Major Michael Scott, Australian Army

Thesis: Due to the high demand historically placed on engineers by an amphibious landing force after it has deployed ashore, how Australian Army Engineers fit into *Australia's Amphibious Concept* must be established in order for the Australian Defence Force to successfully execute amphibious operations, prior to any future such commitment.

Discussion: An Amphibious Operation is a military operation launched from the sea by a naval and landing force with the principal purpose of projecting the landing force ashore tactically into an environment ranging from permissive to hostile. Neither *Australia's Amphibious Concept* nor the derived *Landing Force Concept of Employment* defines the tasks or an organisation for the engineer elements in an amphibious landing force. The documents do, however, indicate that substantial engineering effort will be required to ensure success across the spectrum of operations. Concept documents require the Australian Defence Force to be prepared to conduct amphibious operations into uncertain environments and repeatedly highlight that Humanitarian Assistance and Disaster Relief operations will be a core skill-set of the Landing Force.

Due to space constraints on amphibious ships, which restricts the amount of engineer personnel, vehicles, and equipment that can be carried, the number and type of tasks that can be undertaken by amphibious engineers is also restricted. The challenge therefore becomes determining the most likely tasks that will be required. With these tasks identified and prioritised, an engineer force can be developed that is capable of covering the majority of these tasks while remaining within the space restrictions. The likely tasks for amphibious engineers can be distilled from analysing historical records from operations similar to those that an Australian Amphibious Task Force will undertake or from operations that have occurred in Australia's primary operating environment.

It is proposed that five engineer contingencies be planned to cover the spectrum of possible operations, ranging from a permanent reinforced troop to support defence cooperation and short-notice security missions, to a reinforced combat engineer squadron that is followed by a construction squadron to support entry operations as part of a coalition at the high-intensity conventional end of the operational spectrum. These options, and those in between, carefully balance the limited space for personnel and equipment on the amphibious ships with the array of likely tasks that have been distilled from historical examples for the types of operations that are expected to occur again.

Conclusion: As the list of engineering tasks required to support the full spectrum of operations in the current and future operating environments is quite extensive, an ad hoc engineer group to support the Landing Force cannot simply be formed, nor is there a one-size-fits-all engineer solution. If Australia is to have a serious amphibious capability, the Australian Government and the Australian Defence Force must invest time, effort, and money to ensure that the Australian Army is capable of conducting engineering from the sea.

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Preface

Australia has a long history of joint amphibious operations, commencing with the seizure of Rabaul in German-held New Guinea in the early days of the First World War and then as part of the ill-fated Gallipoli Campaign in 1915. Royal Australian Engineers have played important roles in these amphibious operations, with Sapper Fred Reynolds of the 1st Field Company Engineers recorded as the first soldier to be killed on the Gallipoli Peninsula. The most recent amphibious operations conducted by the Australian Defence Force (ADF) were primarily comprised of engineer forces as part of Humanitarian Assistance and Disaster Relief operations following the large scale natural disasters in Indonesia in 2004-2005 and 2009.

This paper will distil lessons from the employment of engineers in amphibious operations conducted by Australia and its allies from the Second World War (1943) to the present day. These lessons will be applied to the current and future operating environments in which the ADF is likely to operate in order to present a concept for employing Royal Australian Engineers as part of the recently developed *Australia's Amphibious Concept* (March 2010). The model will thereby ensure that suitable engineer options are always available to operational planners and that the Amphibious Task Force Commander will have available a balanced engineer force able to succeed against all problems encountered and capable of enabling both the manoeuvre and support elements.

I would like to thank several people for their very much appreciated assistance with researching and writing this paper. First and foremost my wife, Amanda, and daughter, Hannah, who have endured my absence while studying. From the Marine Corps University, my mentor, Dr Donald F. Bittner; Librarian, Ms Rachel Kingcade; Archivist, Dr Jim Ginther; and from the Leadership Communication Skills Center, Ms Andrea Hamlin. From the USMC, engineers Colonel Tracy King and Lieutenant Colonel Jeff Miller. From the Australian Army, Colonel Jake Ellwood, Lieutenant Colonel Damien Hill, and Major Scott McPherson. Finally, from the UK, Lieutenant Colonel Martin Pryce, RM, and Captain Ben Simpson, RE.

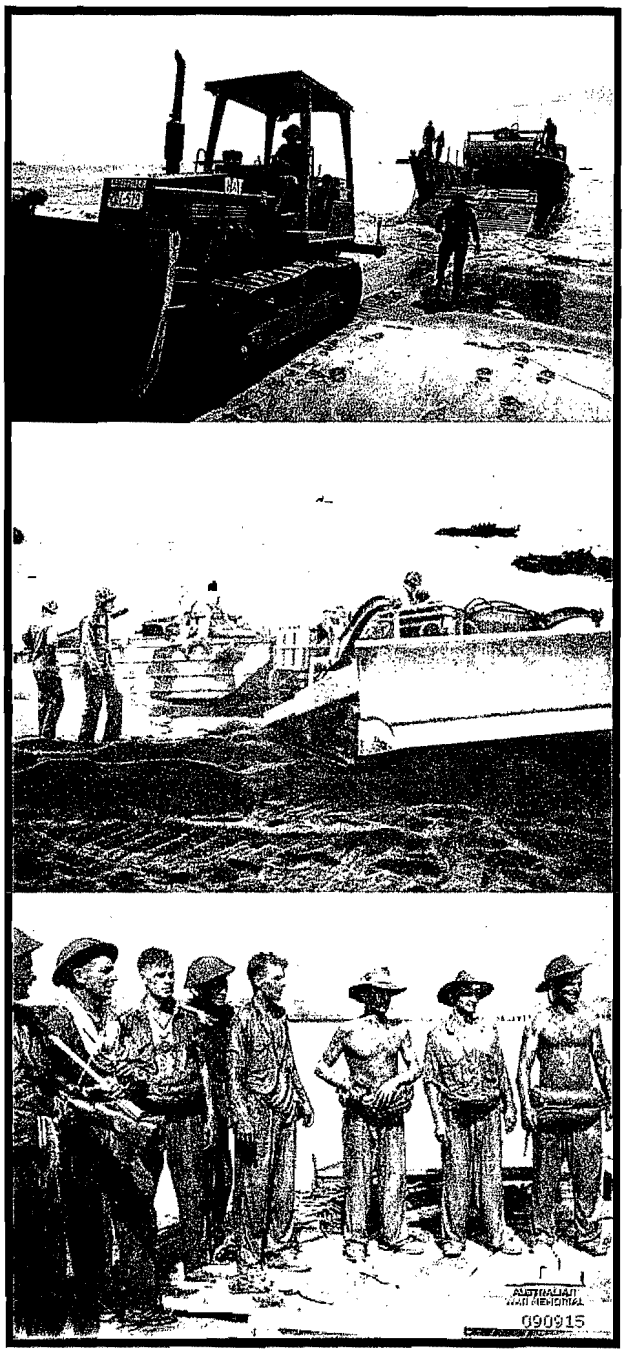

Figure 1. Amphibious Engineers in Sumatra, Iwo Jima, and Borneo

Whether leading the way, or helping others with theirs, Sappers are regularly required to do the dirty work that is essential for mission success. Why then are Engineers often only an afterthought when operations are being planned?

The combat Marine engineer was described as the man who volunteered for nothing, but worked around the clock.

Ralph W. Donnelly, Historical Branch, G-3 Division
Headquarters, U.S. Marine Corps, April 1968
[regarding USMC engineers in WWII][1]

Introduction

The Australian Government stated in its *Defence White Paper 2009* (WP09) that "Australia's defence policy should continue to be founded on the principle of self-reliance in the direct defence of Australia."[2] This White Paper dictated that Australia's military strategy is principally a maritime one and assigned the Australian Defence Force (ADF) a primary operational environment (POE), shown in appendix B, covering approximately 66 million square kilometres – more than 12 percent of the Earth's surface.[3] As a result, the Australian Government decided that this expansive strategic geography requires the ADF to assume an expeditionary orientation[4] at the operational level, underpinned by requisite force projection capabilities.[5] Flowing from this requirement was the purchase of two amphibious *Canberra* class Landing Helicopter Dock (LHD) ships, shown in appendix C, due to enter service between early 2014 and mid-2015, and the planned purchase of a Landing Ship Dock (LSD). In order to provide the required expeditionary amphibious capability, the ADF produced *Australia's Amphibious Concept* (AAC), which articulates the ADF's aspirations for future amphibious warfare across the spectrum of amphibious operations.[6]

Engineers have always played, and will continue to play, a significant role in amphibious operations. The 13th Commandant of the United States Marine Corps (USMC), Major General John A. Lejeune, wrote that the "Marine Corps for many years has carried on certain military activities of an engineering nature. Work which may properly so be designated is performed as a matter of necessity in almost every land campaign."[7] Engineers have also historically been an integral part of all major amphibious operations that Australia and its major allies, the United

States (US) and the United Kingdom (UK), have conducted. Royal Australian Engineers (RAE) have thus played important roles in these amphibious operations, with Sapper[8] Fred Reynolds of the 1st Field Company Engineers recorded as the first soldier to be killed on the Gallipoli Peninsula in 1915.[9] The most recent amphibious operations conducted by the ADF primarily involved engineer forces providing Humanitarian Assistance and Disaster Relief (HA/DR) following large scale natural disasters in Indonesia in 2004-2005 and 2009.

With respect to engineers, neither the AAC nor the more detailed *Landing Force Concept of Employment* 2010 (LF CONEMP)[10] provide more definition than to state that engineers will be part of the Battle Group (BG), around which the Amphibious Task Force (ATF) will base its Landing Force (LF). Despite this, due to the high demand historically placed on engineers by a LF after it has deployed ashore, the nature of how Australian Army Engineers fit into *Australia's Amphibious Concept* must be established in order for the ADF to successfully execute amphibious operations. The nature can be established through an examination and analysis of the engineer tasks and organizations that have contributed to previous successful amphibious operations from the Second World War to Operations ENDURING FREEDOM, conducted by the USMC, Royal Engineers supporting the Royal Marines, and the ADF.

Description of the Military Problem

Australia's Amphibious Concept. The AAC is the concept for the employment of the ADF's amphibious capability to its full potential, complementing and synthesising Future Maritime, Land, Air and Space, and Special Operations Concepts (FMOC, AC-FLOC, FASOC, and FSOC) under Australia's broader Future Joint Operational Concept (FJOC). The AAC links higher-level guidance and operational concepts with ADF operational level doctrine for amphibious operations.[11] The strategic military priorities established in WP09 are reaffirmed in the AAC: deter and defeat armed attacks on Australia, contribute to stability and security in the South

Pacific and East Timor, contribute to military contingencies in the Asia-Pacific Region, and contribute to military contingencies in the rest of the world.[12]

While closely aligned with the USMC's *Amphibious Operations in the 21st Century* and *Marine Corps Operating Concept – Third Edition*, as well as the UK's *Littoral Manoeuvre (Amphibious Task Group) Joint Capability Concept*, the AAC is tailored to secure Australia's strategic interests with a relatively small sized force. The AAC directs that ADF forces be prepared to conduct three distinct types of amphibious missions: Amphibious Operations, Military Support Operations, and Sea Lift. Amphibious Operations are further divided into four types: Demonstration, Raid, Assault, and Withdrawal. Military Support Operations are also further divided: Defence Aid to the Civil Community (DACC) or Defence Force Aid to Civil Authorities (DFACA); Humanitarian Assistance / Disaster Relief (HA/DR); Non-combatant Evacuation Operations (NEO); Peace Operations; Civil Enforcement Duties; and, Inter-Agency, International Organisation, and NGO Liaison and Support. Sea Lift is the "administrative movement of personnel and/or equipment to and within the Joint Force Area of Operations (JFAO)."[13]

In order to be interoperable with allies, the ADF's amphibious concept aspires to develop Australian amphibious thinking based on an Australian analysis and conceptual models from US and UK doctrine. As a result, the four core concepts to underpin the Australian approach to amphibious operations reflect US and UK thinking: Littoral Manoeuvre, Ship-to-Objective Manoeuvre (STOM), Distributed Manoeuvre (DM), and Sea Basing. Like the US and UK, the core concepts require further development in order for the models to be fully implemented.[14]

For a country with relatively limited military assets, the Australian ATF must be flexible and adaptive to conduct sequential and/or simultaneous different missions. The AAC states that the "ATF must be a scalable organisation," "be a balanced, mobile force ... with sufficient

endurance to accomplish the mission," and deploy "without the reliance on host-nation infrastructure."[15] To achieve the large mission set, the AAC bases the future ATF around the deployment and sustainment requirements of the following two organisations:

1. **Amphibious Ready Group (ARG).** The ARG will be capable of the full suite of amphibious tasks. Its manoeuvre component will be a medium-weight Battle Group (BG), of similar size to a USMC Marine Expeditionary Unit (MEU), of approximately 2,200 personnel, with armoured vehicles, associated stores, and equipment. The engineer element will be squadron-sized (equivalent to a USMC company).

2. **Amphibious Ready Element (ARE).** The ARE is a sub-element of the ARG and is primarily focussed on the conduct of HA/DR or NEO missions at very short notice. The manoeuvre component will be an infantry company based Ready Combat Team (RCT) and will include a troop/platoon-sized engineer element.[16]

Neither the AAC nor the derived LF CONEMP defines tasks or an organisation for the engineer elements. The documents do, however, imply that substantial engineering effort will be required to ensure success. The LF CONEMP states that the "ADF is to be prepared to conduct amphibious assault[s] ... into uncertain ... environments"[17] and repeatedly highlights that HA/DR operations will be a core skill-set of the LF. As the list of engineering tasks required to support these operations is quite extensive, an ad hoc engineer group to support the LF cannot simply be put together without a detailed analysis of what it will likely do, what personnel and equipment it will require, and what training it will need.

Historical Examples of the Employment of Engineers in Amphibious Operations

A brief study of amphibious operational history highlights the utility of engineers and the fact that they were crucial for the manoeuvre elements in combat. The study of operational campaigns since 1943 provide examples of likely combat operations in the ADF's POE: the

USMC and RAE in New Guinea and the Central Pacific in the Second World War; the Royal Marines as they landed and advanced to their objective in the Falkland Islands (1982); the USMC entry operations into Somalia, with a focus on a low-mid intensity security environment (1992-1993); and finally, the 2001 operations of the 15th MEU and 26th MEU for a planned NEO and the executed operations that seized two airfields inside Afghanistan in the early stages of Operation ENDURING FREEDOM. All tasks noted were conducted within the first 30 days (many within the first seven days) of a LF deploying ashore, which is well inside the mission duration that has been set for the ARG.[18] See appendix D for a detailed list of engineer tasks undertaken in these operations.

World War II. The strongest theme that emerged from analysing the official records of operations in New Guinea, including Gape Gloucester, on Saipan, and in Borneo can be simply stated: terrain was very restrictive to the movement of the LFs.[19] The lack of key infrastructure in the region, such as roads and bridges, resulted in engineers providing the required mobility through the expedient construction and maintenance of beach exits, tracks, corduroy roads, and bridges. (A lack of infrastructure in the ADF's POE is still the case today.) These tasks were made all the more difficult during the extensive monsoon season, with its influence on both rain and surf. The weather was not the only challenge, as engineer tasks frequently had to be completed under enemy fire, often without protection.[20] Other common tasks included obstacle reduction, minefield clearance, booby trap clearance, and the destruction of enemy strong points to enhance mobility. General engineering tasks also had to be completed, including water supply, rapid airfield repair and improvement, and camp construction.[21] In addition, the vast majority of amphibious engineers in the Second World War were required to execute infantry tasks, i.e. engage in combat, the engineer's ubiquitous secondary role.

The Falkland Islands, 1982. The Royal Engineers' reinforced 59 Independent Commando Squadron (Five-Nine), which included a reconnaissance troop and a troop from 9 Parachute Squadron RE,[22] provided the mobility and survivability support to 3 Commando Brigade (3 CDO BDE RM) when it secured a beachhead at San Carlos in East Falkland. The squadron then supported the advance east to the final objective, Stanley. While relatively light, with regards to engineering vehicles and specialist equipment, the amphibious engineers played a significant role in the operations to recapture the Falkland Islands. In addition to fighting as infantry, the significant engineer tasks Five-Nine undertook included improving beach exits and roads; constructing hardstands; reconnoitring, breaching and clearing minefields and obstacles; rendering safe explosive ordnance and booby traps; constructing fighting positions and strong-points; and water supply operations. Once the beachhead was secure, additional Royal Engineer units were brought ashore to undertake the numerous general engineering tasks required to support the larger task force.[23] The Commander of 3 CDO BDE RM wrote in his account of the war: "In war there are never enough Sappers and the support given to the Commando Brigade by its Engineer Squadron, which included a Troop from 9 Squadron, was superb."[24]

Somalia, 1992-1993. The 1st Combat Engineer Battalion (1 CEB) supported with a reinforced combat engineer company the initial insertion of the Special Purpose Marine Air Ground Task Force (SPMAGTF) into Somalia, as part of Operation RESTORE HOPE. The bulk of effort provided by the company from 1 CEB at the start of the operation was on mobility tasks, including route reconnaissance, route maintenance, route clearance, mine clearance, and work to open the port facilities. Survivability was another high priority, including strong point construction and facility hardening, as well as the provision of water and general security tasks. After the initial insertion of the SPMAGTF, additional engineers were flowed into theatre from 1 CEB, as well as from the US Navy Seabees, the Marine Wing Support Squadron (MWSS), and

the 7th Engineer Support Battalion (7 ESB). At the 18 day mark, approximately 1,300 engineers worked for the Marine Forces.[25] An official and important lesson that emerged from Operation RESTORE HOPE: UN "chapter VI and VII operations [that is, Military Operations Other Than War] in third world countries place high demands on engineer support."[26]

Afghanistan, 2001. The seizure in late 2001 of FOB Rhino and Kandahar Airport by Task Force 58 (TF 58), consisting of the 15th MEU and the 26th MEU, is the most recent amphibious combat operation studied. Engineer support to this operation was crucial to the rapid build up of forces in Afghanistan and was almost exclusively flown in, initially by helicopter, then by KC-130 aircraft, and finally by C-17 transporters. Each MEU was supported by a reinforced combat engineer platoon, a reinforced support engineer platoon, a MWSS detachment, and an enlarged EOD section. TF 58 was also reinforced with a Chemical Biological Inspection Site Team and a Seabee detachment of 30 engineers. The key tasks conducted by TF 58 engineers were the rapid repair and expansion of the two airfields and helicopter landing zones; the conduct of high risk search tasks; the clearance of mines, booby traps, and explosive ordnance; the construction of fighting positions, strong points, and berms; the construction of hygiene-related camp facilities; and the building of detainee compounds. Of particular note is the fact that both the 15th MEU and the 26th MEU were afloat when the events of September 11 occurred. Thus, neither MEU was task organized for this specific mission but they were prepared for it.[27]

Indonesia 2004-05 and 2009. Since late-2004, the 1st Combat Engineer Regiment (1 CER) has twice provided short notice amphibious engineer forces for large scale HA/DR operations in Indonesia. In response to the devastating 2004 Boxing Day Indian Ocean Tsunami, 1 CER provided the main ADF contingent as part of the Australian Government's response in Banda Aceh. Here, it focused on water supply and debris clearance in order to reduce environmental health threats. In response to the 2009 magnitude 7.5 earthquake off Western Sumatra, 1 CER

again provided the main ADF contingent to the Australian Government's response in Padang. On this occasion, it focused on water supply, structural building assessments, rendering safe important buildings, minor repairs to key lines of communication (LOC), and construction of semi-permanent medical centres. While both responses were very similar in nature, before deployment no contingency plans existed. This resulted in planning from first principles, i.e. with a limited knowledge base for such an operation. 1 CER was very successful in both operations, largely due to the individuals who were available at the time to rapidly plan the tasks and then execute a quickly developed plan, providing modifications to it as required.[28] A breakdown of the Engineer Task Group for Operation PADANG ASSIST (2009 operation) is in appendix E.

Whether in the ADF's POE or further afield, the range of engineer tasks required for an amphibious operation are vast, although common throughout, and cover the majority of tasks for which RAE sappers train. The review of historical operations showed that combat, support, and specialist engineers were required, both individually and collectively, to complete the work and, on occasion, required supplementation. The historical employment of engineers on amphibious operations can help predict how engineers will be used on future expeditionary operations.

How Other Amphibious Forces Employ their Engineers

United States Marine Corps. USMC engineer role, tasks, organisation, and principles of employment differ significantly from that of Royal Australian Engineers. Thus, the USMC template cannot simply be transferred to the Australian ARG, even though the manoeuvre element is similar in structure to a USMC MEU. For example, petroleum operators and engineer vehicle mechanics are USMC engineer specialities but not RAE trades; conversely, electricians and EOD technicians are RAE trades but not USMC engineer specialities. In addition, USMC combat engineer units have neither organic transport/drivers nor protected mobility vehicles to support a mechanized combat team. Overall, USMC engineers independently support the four

elements of a MAGTF: Command Element (CE), Ground Combat Element (GCE), Air Combat Element (ACE), and the Logistics Combat Element (LCE). As these four elements will exist in an Australian ARG, while named and organised differently, the task and break-down of forces provide a good reference point. In addition, in order to expand on capabilities that do not exist in the USMC (but exist within RAE CERs and 6 ESR), a scalable and tailored Naval Construction Force (NCF) will often be attached. Typical engineer support to a MEU is shown in Figure 1. The engineer elements total approximately 103 to 120 personnel, without including the NCF.[29]

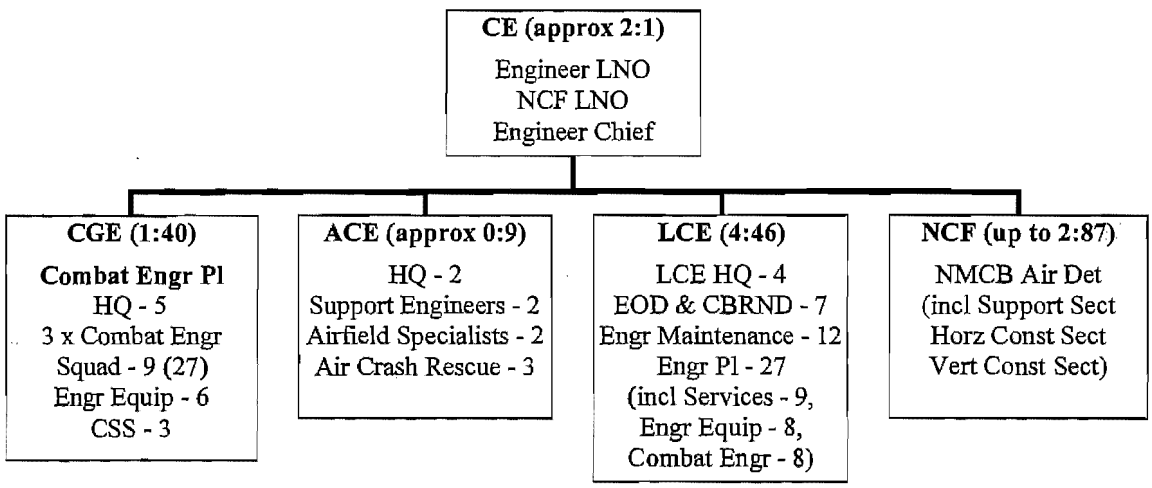

Figure 2. Current Generic Engineer Support to a MEU

A detailed breakdown of the engineer elements of the 15th MEU in late-2001, as well as the breakdown of the current II MEF structure for engineer support to a MEU, is in appendix E.

The *USMC 2024 Baseline MEB and MEU* provides the future force structure of USMC manoeuvre formations, including their engineer elements.[30] This baseline, used for future force concept modelling, includes very few changes to the engineer organisations organic to a MEU. The GCE is still supported by a reinforced combat engineer platoon and a reinforced engineer platoon is included in the Combat Logistics Battalion (CLB). It can thus be deduced that the method by which the USMC employs its engineers will only substantially differ when the concepts of operation for USMC manoeuvre formations change significantly.

Royal Marines, Great Britain. The support provided by 24 Commando Engineer Regiment, Royal Engineers (24 Cdo Engr Regt, RE) to 3 CDO BDE RM is relatively light. This reflects the fact that 3 CDO BDE RM is a light-medium expeditionary force that does not include significant armoured elements, such as tanks, in its order of battle. Having previously supported the entire 3 CDO BDE RM with one regular Independent Commando Squadron (Five-Nine), the Royal Engineers are now upsizing to support the Brigade with an Engineer Regiment.[31] This is in accordance with the Australian model and highlights the fact that amphibious operations require considerable engineer support in order to attain success. The Royal Engineers provide support to a battalion-size Royal Marine Commando Battle Group with a squadron-size element, totalling approximately 126 to 173 personnel. The typical organization is shown below in Figure 2.[32]

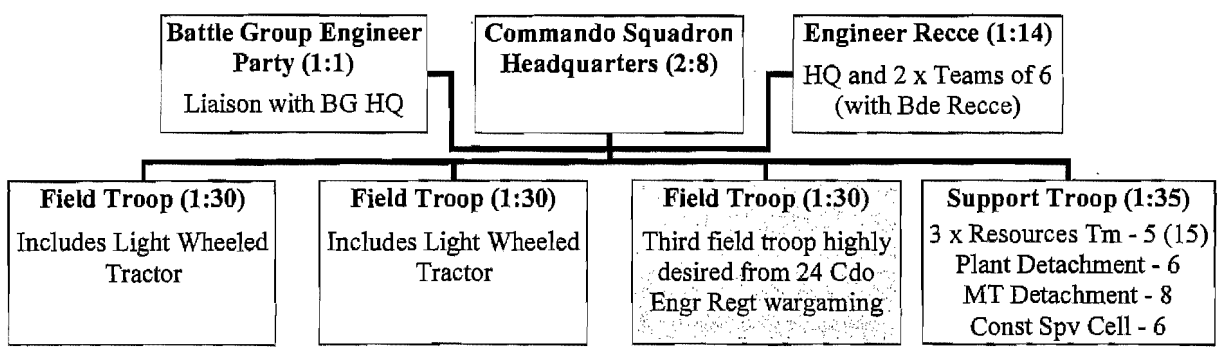

Figure 3. Royal Engineer Support to a Royal Marine Commando Battle Group

Australian Army. In accordance with Australian doctrine, the appropriate level of engineer support to an Australian BG is usually provided by a combat engineer squadron, with a combat engineer troop supporting an independent company-sized combat team.[33] This is not always strictly followed, with the size and composition often adjusted to cater for specific missions and operational environments. Currently in Afghanistan, a combat engineer squadron, reinforced with additional combat engineers and support engineers, provides the increased support required by the combined arms BG. This level of support is predicated on the level of threat, type of weapons being used by the opposing forces, and the counter-insurgency mission of the BG. As

Australia does not currently possess a dedicated amphibious capability, the engineer support to an amphibious operation is usually ad hoc. Another real world complicating factor exists: force structure is generally based on limits set by a manning cap rather than on an analysis of historically based likely tasks.

The Current and Future Operating Environments

Studies in Australia, the US, and the UK,[34] have predicted similar future global and regional security environments (some of which may be attributed to 'group thinking').[35] Traditionally, inter-state wars, involving conflict between armed forces purpose-built for engaging in conventional combat (symmetrical warfare), have been the main focus of defence planning by Australia and its allies. In recent years, intra-state conflict among different political, ethnic or religious groups has come more to the fore in places such as Iraq and Afghanistan, where conventional military forces have had to work alongside civilian agencies and NGOs. Moreover, threats from some non-state global actors, such as al-Qaeda, have meant that armed forces have had to be employed against new types of adaptive adversaries. All of this has resulted in what is termed 'Complex War' or asymmetrical warfare. While globalisation has seen growing interdependence between states, the Australian Government still considered it premature to rule out future conventional wars between states, including the major powers.[36]

The ADF does not currently operate in a single environment; instead, it can be deployed from urban environments to jungles, from deserts to mountains. Both now and in the future, global factors (including terrorism, pandemic disease, population growth, resource depletion, and climate change security implications) as well as specific Asia-Pacific region factors (such as state fragility, poor governance, and economic underdevelopment and inequality) will likely affect Australia's security interests, both directly and indirectly. Compounding these threats will be factors such as globalisation, urbanisation, the rise of new military powers, new technologies, and

other non-traditional challenges.[37] Traditional societal structures and the ability of states to provide essential services as well as law and order will continue to be stressed by population and urban growth, no more so than in Melanesia and Southeast Asia.[38] The principal physical characteristics of the ADF's POE are its littoral nature, vast spaces between areas of human habitation, and the presence of complex terrain. The broad range of topographical features tends to combine so that urban areas exist in close proximity to a mixture of agrarian land, coastal planes, mountains, tropical vegetation, and coastal waterways.[39] Compounding these environmental challenges are the frequent natural disasters than occur in the Southeast Asian and Pacific regions, most notably the seismic activity along the fault lines of the 'ring of fire.'

The global and regional security environment means that the ADF should be prepared to face opponents who utilise the following capabilities: readily available 'low tech' capabilities; increasingly secure and sophisticated networked command and control, and ISR systems; increasingly conventional platforms that enhance lethality, survivability, and deployability; and, increasingly available advanced conventional weapons as well as chemical, biological, radiological, nuclear, and explosive (CBRNE) devices.[40] States now no longer possess the monopoly on advanced weaponry, as non-state actors, such as terrorist groups and irregular forces, have acquired the means, knowledge, and employment capability of increased lethality.[41] The conventional capabilities of many states will also improve, so both state and non-state adversaries will be able to acquire increased lethality. A significant trend has developed in recent conflicts where previous notions of distinct forms of war and conflict – conventional war, irregular challenges, terrorism, and criminal activity – have become blurred into what is being described as hybrid challenges. These hybrid challenges can be created by state and non-state groups, and will result in opponents that can merge different approaches and integrate various

weapons, tactics, and technologies to deny access and freedom of action.[42] A recent example is the 2006 Israel-Lebanon conflict is.[43]

From modelling and analysis of likely futures threats and the future operating environment, the Defence Science and Technology Organisation (DSTO) concluded that an Australian ATF must be capable of conducting advance force operations to delay, deny, seize, deceive, and block; providing combine arms teams to establish and protect a beachhead; and, while conducting urban operations, seize and hold a Sea Point of Disembarkation (SPOD) and/or an Air Point of Disembarkation (APOD). These tasks are reflected in the AAC and the LF CONEMP. All of these capabilities require substantial engineer support.[44] The DSTO report highlights that engineers are critical to any amphibious assault, providing likely scenarios that demonstrate that all manoeuvre elements will require engineer support. This includes some form of plant equipment, thus further emphasising support engineer logistical planning and capability.

There are numerous implications for the conduct of engineer operations arising from the forecast of the security environment in which the ADF will operate in the next 20 to 30 years. Firstly, terrain in the littoral areas will provide significant mobility challenges that engineers will need to overcome. This harks back to operations in New Guinea and the Pacific during the Second World War, where engineers directly influenced and contributed to the speed at which operations were executed. Secondly, the ADF's adversaries will use various combinations of conventional and improvised weapons systems to attack a LF. These may combine conventional minefields and obstacles with improvised explosive devices (IEDs) and booby traps in urban terrain, including at airfields and ports that may be used for the ingress of follow-on forces. Finally, the frequency with which natural disasters, such as earthquakes, tsunamis, volcanic eruptions, and cyclones have occurred in the past six years within Australia's POE, will ensure that the ADF's response in HA/DR operations is engineer intensive.

Capabilities Required of the Amphibious Engineer Force

What do the future operation environment and historical employment of amphibious engineers indicate? Individualised lethality of modern weapons and the disaggregated battlespace means that in Complex War, land forces will encounter more lethal enemies, with less warning, in close combat, and in complex terrain. Therefore, all deployed land force elements, including engineers, will need to be given sufficient levels of protection, mobility, and firepower to conduct sustained close combat within the complex battlespace. Importantly, the land force will need to survive first contact with the enemy and react accordingly. Additionally, AC-FLOC states "the land force will need the capacity to conduct rapid route clearance and gap crossing, maintain essential lines of communication, and operate within a contaminated environment."[45]

Today and in the future, the combat and support engineers bring to the battlefield both constructive (e.g. building strong points and providing essential services) and destructive (e.g. obstacle breaching and demolitions) capabilities. This unique amalgamation of contrasting capabilities provides skills, knowledge, and experience to commanders at the operational and tactical levels with which the commanders can reduce friction, facilitate manoeuvre, and increase the morale of friendly forces, or create friction and disorder to break the cohesion of the enemy. The combat engineer earns his title most notably through assault breaching of enemy obstacles and fortifications, or by their contribution of firepower in the form of supplementary infantry support. The capabilities provided can be decisive in maintaining momentum in the attack or responding quickly to an enemy's counter-attack.[46] These required engineer capabilities are common to all current and future operations, not just amphibious operations. Due to space constraints on the amphibious ships, which restricts the amount of engineer personnel, vehicles, and equipment that can be carried, the number and type of tasks that can be undertaken by amphibious engineers is also restricted.

The challenge therefore becomes determining or prioritising the most likely tasks that will be required. Once done, an engineer force can be developed that is capable of covering the majority of these tasks while remaining within the space restrictions. The wide range of military and engineer tasks for which the ADF is required to prepare, across the full spectrum of operations in the current and future operating environments, means that there cannot be a one-size-fits-all engineer solution. Therefore, five likely scenarios are proposed in this paper. These cover the spectrum of amphibious operations with their abundant engineer options. The scenarios are as follows:

Scenario 1. Support to an ARE conducting Phase Zero (Shaping) operations, minor HA/DR operations, and NEO. Engineer tasks will include minor vertical and horizontal construction, including strong points, searches for unsophisticated IEDs, and water supply.

Scenario 2. An Engineer Task Force conducting a major HA/DR operation as a result of a 'large scale' natural disaster, such as the Indian Ocean Boxing Day Tsunami. Engineer tasks will focus on water supply and debris clearance in order to reduce environmental health threats as well as structural building assessments, rendering safe important buildings, minor repairs to key LOC, and construction of semi-permanent community health buildings.

Scenario 3. Support to an ARG conducting regional stability operations, such as the Regional Assistance Mission to the Solomon Islands in 2003 and East Timor in 2006. Engineer tasks will include clearing beach obstacles, countering unsophisticated IEDs, minimal preparation of beach landing sites, and small-scale expedient construction tasks.

Scenario 4. Support to an ARG conducting entry operations for a medium intensity regional conflict, such as for the International Force East Timor (INTERFET) in 1999. Engineer tasks will include clearing beach obstacles, clearing basic IED/mine threat against

air operations, countering IED threats on roads, the construction/enhancement of Landing Zones (LZ), preparation of beach landing sites, and basic camp hardstand construction.

Scenario 5. Support to an ARG conducting entry operations for a major regional conflict involving a Coalition Task Force, in the manners of 3 CDO BDE RM in the Falkland Islands in 1982 and 15th/26th MEU in seizing APODs in Afghanistan in 2001. Engineer tasks will include clearing beach obstacles, clearing sophisticated IED/mine threats targeting air operations, countering sophisticated IED threats on roads, breaching or clearing a mine threat, the construction of LZs, preparation of beach landing sites, the construction and maintenance of routes, basic camp construction, and the construction of defences.

The likely tasks for amphibious engineers can be distilled from analysing historical records from operations similar to those that the Australian ATF will undertake, described in the five scenarios, or from operations that have occurred in Australia's POE. A detailed list of the most likely tasks distilled from previous operations, and sorted by scenario, is in appendix F.

From these task lists it can be seen that a mixture of combat, support, and specialist engineers is required for low-intensity missions such as Phase Zero operations, HA/DR operations, and small-scale security operations. The majority of these engineers reside in a CER. The analysis also shows that for large-scale high-intensity operations, where the ATF conducts entry operations for a follow-on force, the variety and number of simultaneous engineer tasks that will be encountered will require a follow-on engineer force. Initially independent, it may then function as part of a coalition engineer capability to facilitate the flow of the ensuing forces. The majority of engineer tasks required to secure the points of entry, however, can be executed within the existing capabilities of a CER by a reinforced combat engineer squadron.

What is not captured in the task analysis is the **requirement for the provision of engineer advice and engineer planning**. Due to the fact that there are so many different engineer tasks,

the vast majority of which require technical knowledge to plan and execute, it is essential that engineers are represented from the outset in all operations planning processes.[47] Therefore, an engineer planner, or at least an engineer liaison officer (LNO), must always be included in ATF planning groups as well as in the LF Headquarters. While this function is sometimes filled by the headquarters of the engineer force, the need for the engineer headquarters to monitor and control engineer tasks results in this element often being physically distanced from the supported BG Headquarters. As such, it is recommended that an RAE Officer always be included in the LF Headquarters, either as a permanent LNO or as one of the Operations Cell staff.

Concept of Employment

Assumptions and Restrictions. For the development of engineer options it has been assumed that the light vehicles, Protected Mobility Vehicles (PMVs), and trucks will be replaced with similar vehicles as part of the current ADF land vehicle fleet replacement program. It is also assumed that medical support to the engineer element will either be provided by the supported BG element or by the main Combat Service Support (CSS) element, except for Scenario Two where the medical element would be organic. Finally, it is assumed that the follow-on engineer element will be transported by either black-bottom vessels or coalition ships.

A feasible and suitable engineer solution to the outlined problem must be within the restrictions set by the ADF. The LF CONEMP and modelling data used by the JACIT gives the size of engineer force and its equipment for which there is space available on the amphibious ships. The publication *Employment of Engineers* provides the governing principles and guidelines for the employment of engineers by the Australian Army. Documents for the Modular Engineer Force, which is the RAE's ongoing Force Modernisation Review, provide the guidance as to how engineers will meet future warfighting challenges and how they will be commanded and controlled. These documents provided the following constraints for this analysis:

Table 1. Constraints on the Employment of Engineers used in the Analysis

No.	Constraint Details	How Constraint Applies
1	The **Load Planner** for the ARG used an estimate of 158 engineers, 14 armoured vehicles, 5 light vehicles with 4 trailers, 3 medium-weight trucks with 5 trailers, 8 heavy trucks with 2 heavy trailers, 1 water purification unit, 6 tracked plant machines, and 4 wheeled plant machines. This provides total lane meterage of 413.7m.[48]	The engineer element supporting an ARG can have a strength of up to 158 persons and can have a maximum total lane meterage of 413.7m.
2	The **Load Planner** for the ARE used an estimate of 15 engineers, 2 PMVs, and no additional engineer equipment. As this load calculator had a spare capacity of 446 persons but only 3 lane meters, it is also assumed that up to 50 engineers can be used.[49]	The engineer element supporting an ARE can have a strength of up to 50 persons.
3	The **secondary role** of RAE is to fight as infantry.[50]	For low-intensity operations, such as Phase Zero and NEO, engineers can also perform the roles of infantry.
4	The **solution** must have centralised control with decentralised execution.[51]	The engineer element must have one overall headquarters for planning and coordination.
5	**Early warning and reconnaissance** – engineers must have participants in the planning of operations at the outset and be given the opportunity to conduct reconnaissance.[52]	There must be an engineer in the headquarters as well as part of any reconnaissance team.
6	**Economy of effort** – it is uneconomical either to apply more engineer effort than is necessary to complete tasks in the required time, or to use engineer effort on the unskilled aspects of engineer tasks.[53]	Only the minimum number of engineers are included; however, engineer positions cannot be sacrificed for personnel who can provide unskilled labour.
7	The appropriate **levels of engineer support** for most types of operations are as follows: combat engineer troop to a manoeuvre sub-unit, and combat engineer squadron to a manoeuvre unit.[54]	ARE will be supported by a reinforced troop and the ARG will be supported by a reinforced squadron.
8	**Engineer sections** will have 8 members.[55] This does not include the sections with protected mobility, which require a dedicated Crew Commander and a Driver.	The light combat engineer elements will have 8 man sections, while the mechanised combat engineer elements will have 10 man sections.

Scalable Options. Taking into account the above constraints, the five scenarios covering the likely employment of engineers in amphibious operations necessitate five different and scalable organisation options, due to the size of the force being support, type of amphibious mission being

supported, and the variety of resulting tasks. A detailed organization wire-diagram for each option is in appendix G. An overview of each option is as follows.

Scenario 1 – Support to an ARE conducting Phase Zero (Shaping) operations, minor HA/DR operations, and NEO. As the ARE is of company-size, it requires a reinforced troop-sized option. The likely security cooperation and minor HA/DR missions, which will dominate the ARE deployments, will most probably involve light construction. This would require four tradesmen and two plant operators. (Tradesmen are sappers that are Army trained with a civilian-recognised trade qualification. RAE construction trades are carpenter, plumber, and electrician.) The military tradesmen would supervise construction works by the combat engineers as well as undertake specialist trade work. Two mechanized sections are included to provide protected engineer support to the combat team and can additionally serve as infantry sections for security operations. The light combat engineer section is air mobile, providing mobility capabilities, such as search, as well as the ability to conduct water supply tasks. The troop is reinforced with a two-man EOD detachment and two Explosive Detection Dog (EDD) teams,[56] to increase the search and explosive ordnance capabilities of the troop. The troop has organic transport, a storeman, and a mechanic. Planning with the ARE Headquarters would be provided by an RAE Captain, as either a LNO or Operations Staff member, as well as a Geospatial Technician (Geotech).

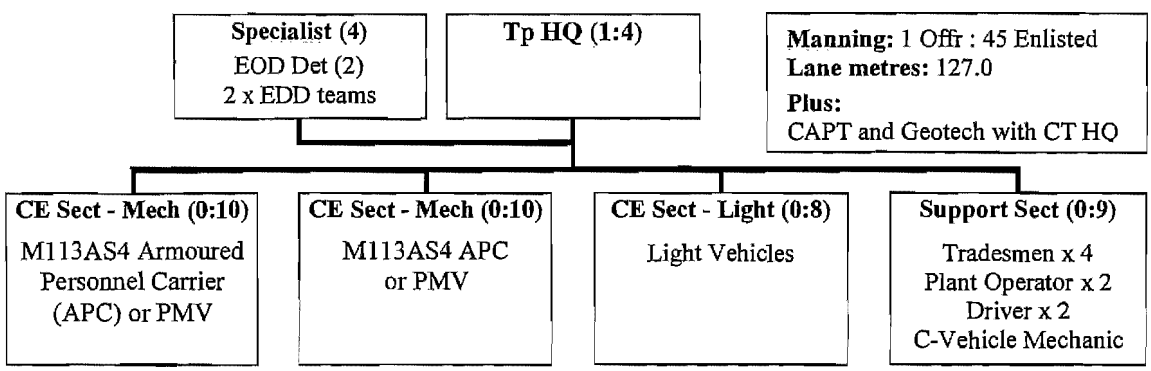

Figure 4. Engineer Support to an ARE (Scenario 1)

Scenario 2 – An Engineer Task Force conducting a major HA/DR operation as a result of a 'large scale' natural disaster. The scale of such a disaster would require a dedicated Engineer Task Force to be deployed. As the engineer group forms the nucleus of the ATF, this option would include a sizeable organic logistics (CSS) element. A chaplain and a minimum of two interpreters are included due to the nature of the work being undertaken. The option includes two combat engineer troops, one dedicated to water supply tasks and the other to general engineering, as well as medium weight plant and tradesmen elements. An Emergency Response detachment has been included to handle potentially hazardous materials, such as asbestos. An RAE Captain is included in the JTF Headquarters, as well as a Geotech. It is also more than likely that a technically qualified Structural Assessment Team, supplemented from outside a CER, would be required to technically assess building and bridge damage.

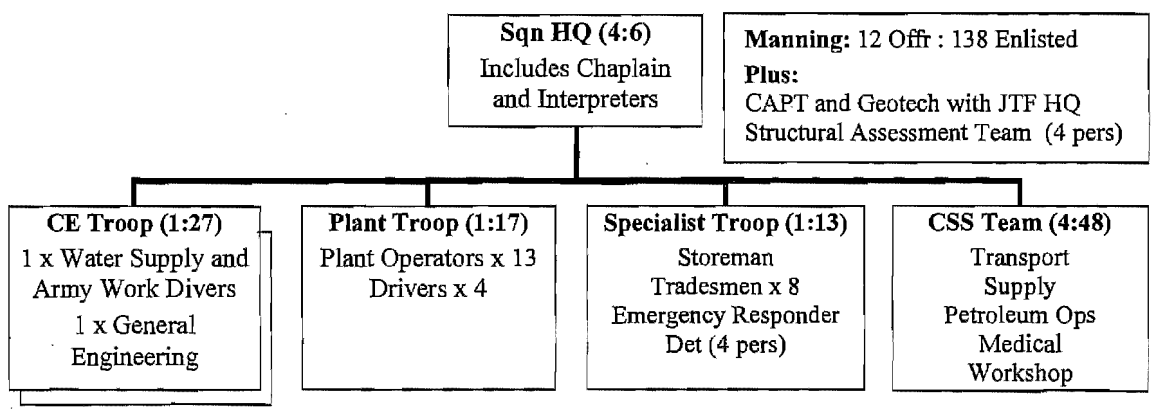

Figure 5. Engineer Support to a Major HA/DR Operation (Scenario 2)

Scenario 3 – Support to an ARG conducting regional stability operations. As the ARG is battalion-size, it requires a reinforced engineer squadron for support. Two combat engineer troops would support the manoeuvre forces: a mechanized troop supporting the two mechanized combat teams and a light troop, with organic transport, supporting the two air mobile combat teams. The substantial general engineering tasks required of this mission, primarily the construction and maintenance of roads and airfields, as well as the construction of camp

infrastructure and survivability tasks, demands a light-medium weight support engineering troop. A specialist troop is also included to provide the suite of likely EOD, EDD, and hazardous material capabilities. The EOD Team would use a Buffalo-type Mine Protected Clearance Vehicle (MPVC), as is currently being used to counter the IED threat in Iraq and Afghanistan. Planning with the ARG Headquarters would be provided by the Squadron Headquarters. No follow-on engineer element is required, unless the situation escalates and the ARG is reinforced.

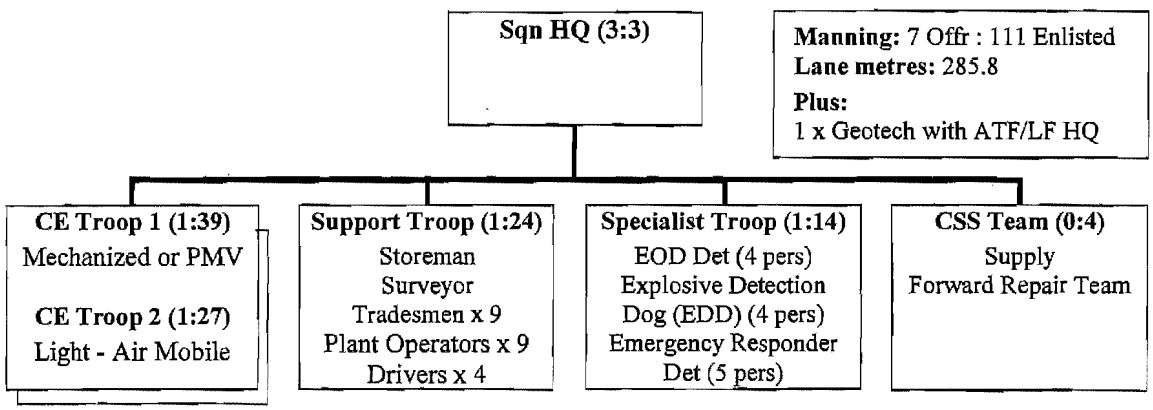

Figure 6. Engineer Support to an ARG – Regional Stability Operations (Scenario 3)

Scenario 4 – Support to an ARG conducting entry operations for a medium intensity regional conflict. This option builds on the solution provided for in Scenario 3 by including two Assault Breacher Vehicles (ABV) and a follow-on engineer force. The latter would comprise a Works Team and construction squadron detachment. The ABVs are included with the mechanized troop to recognise the heightened IED and mine threat, providing the ability to conduct rapid route clearance, minefield and obstacle breaching, as well as the reduction of enemy strong points. The Works Team and construction squadron detachment are required to deploy, by either black-bottom or coalition shipping, to supplement the support engineer assets with the combat engineer squadron. The tasks of this follow-on force will primarily involve camp construction for the follow on Battle Group(s), the construction and maintenance of roads, the expansion and maintenance of airfield(s), and the establishment of APODs and SPODs.

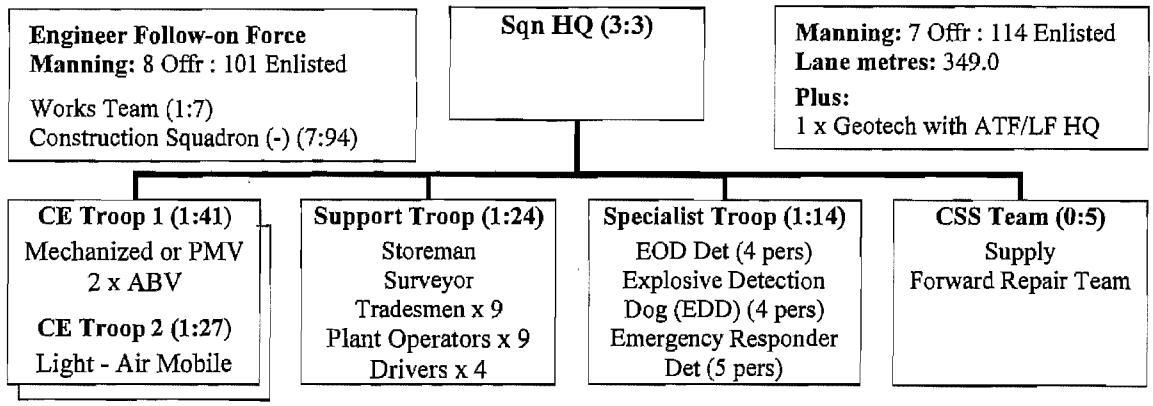

Figure 7. Engineer Support to an ARG – Medium Intensity Regional Conflict (Scenario 4)

Scenario 5 – Support to an ARG conducting entry operations for a major regional conflict involving a Coalition Task Force. This option builds on the solution postulated for in Scenario 4. The Squadron Headquarters becomes mechanized, an Armoured Vehicle Launched Bridge (AVLB) is added to the mechanized troop, an additional combat engineer section is added to the light combat engineer troop, the number of EOD teams is increased, an Air Crash Rescue (ACR) team is included, and the follow-on engineer force is expanded to comprise a Works Team and a complete Construction Squadron. Mechanizing the headquarters provides it with the required protected mobility to conduct engineer reconnaissance tasks in the high-threat environment. The AVLB will allow the provision of protected tactical gap crossing capabilities. The additional engineer section is included to balance the support available to the air mobile combat teams, which may be distributed due to the increased air threat. The increased air threat predicates the requirement to augment the Emergency Response detachment by including an ACR Team. The heightened IED threat demands the increase of EOD capabilities, as has been experienced in Afghanistan. Finally, as the Australian ATF may be providing entry operations for a coalition follow-on force, the follow-on engineer force has been enlarged to cope with the increased demand for engineer works. The follow-on construction squadron would initially operate under command of the ARG, but would in time become part of the coalition engineers. When

functioning as part of the coalition engineers, a LNO would be required, in addition to a level of command and control appropriate to the coalition.

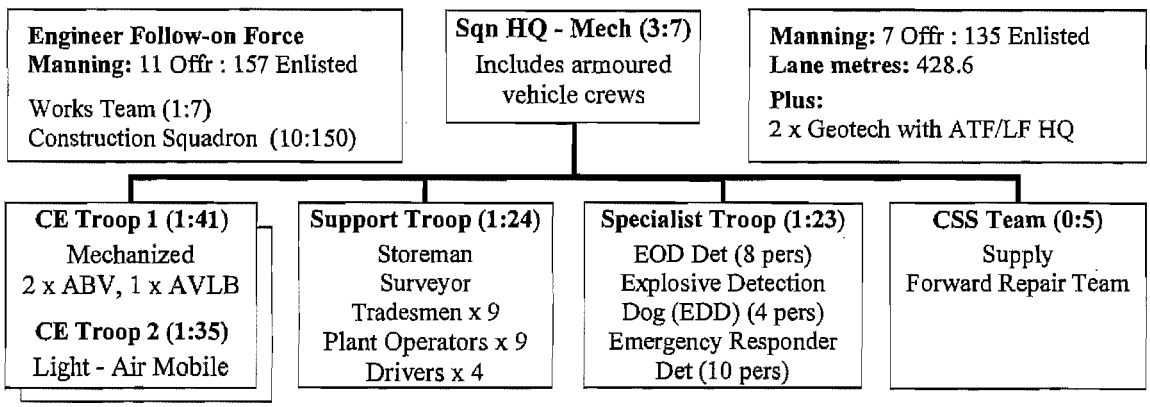

Figure 8. Engineer Support to an ARG – Major Regional Conflict (Scenario 5)

Required materiel. The vast majority of vehicles and engineer equipment required to provide the recommended engineer support is either currently in service or will come into service as part of ongoing Army vehicle fleet replacement programmes. Currently the Australian Army lacks any form of protected specialist combat engineering equipment, which goes against requirements of both the WP09[57] and the AAC.[58] In order for this issue to be remedied, a Buffalo-type MPVC, the ABV, and an AVLB need to be included in the ADF's Defence Capability Plan.

Conclusion

The Australian Government has decreed that Australia's military strategy is principally a maritime one and that the ADF is to assume an expeditionary orientation at the operational level, underpinned by requisite force projection capabilities. The ADF has responded to this by developing an amphibious capability, with an Amphibious Task Force consisting of two LHDs and a planned LSD to deliver a medium-weight battalion-size Battle Group to its Area of Operations. Underpinning this capability is *Australia's Amphibious Concept*, which links higher-level guidance and operational concepts with ADF operational level doctrine for amphibious

operations. The concept, and its supporting Concepts of Employment, states the need for engineers to support amphibious operations, but specifies neither likely tasks nor organization.

Engineers have historically always played a key enabling, and sometimes leading, role in amphibious operations, more often than not receiving praise for their work in post operational reports. The future operating environment will continue to demand that engineers enable, support, and enhance the manoeuvre elements of a Joint Task Force by providing mobility, counter-mobility, survivability, and sustainability to these combat arms in likely hybrid threat environments. Because of the wide spectrum of operations that exist both now and into the future, the required enabling tasks are too numerous to be covered by a single engineer organisation.

It is therefore proposed that five engineer contingencies be planned to cover the spectrum of possible operations, ranging from a permanent reinforced troop to support defence cooperation and short-notice security missions, to a reinforced combat engineer squadron that is followed by a construction squadron to support forced entry operations as part of a coalition at the high-intensity end of the operational spectrum. These options, and those in between, carefully balance the limited space for personnel and equipment on the amphibious ships with the array of likely tasks that have been distilled from historical examples for the types of operations that are expected to occur again. If Australia is to have a serious amphibious capability, the Australian Government and the Australian Defence Force must genuinely invest time, effort, and money to ensure that the Australian Army is capable of conducting engineering from the sea.

Endnotes

[1] Ralph W. Donnelly, "A Brief History of U.S. Marine Engineers," Marine Corps History Division, April 1968, 9, https://www.intranet.tecom.usmc.mil/sites/History%20Division/default.aspx.

[2] Australian Government, Department of Defence, *Defending Australia in the Asia Pacific Century: Force 2030*, Defence White Paper 2009 (Canberra, ACT: Department of Defence, 2009), 48. Cited hereafter as Australian Government, *Defence White Paper 2009*.

[3] Australian Defence Force, *Australia's Amphibious Concept (AAC) v5.2* (U) (Canberra, ACT: Joint Amphibious Capability Implementation Team, March 2010), 4. Cited hereafter as Australian Defence Force, *AAC*.

Australian Government, *Defence White Paper 2009*, 51. The primary operational environment (POE) extends from the eastern Indian Ocean to the island states of Polynesia and from the equator to the Southern Ocean. That area contains all Australian sovereign, offshore and economic territories, such as Cocos (Keeling) Islands, Christmas Island, Heard and McDonald Islands, Macquarie Island, Norfolk Island, plus waters adjacent to the Australian Antarctic Territory. A map of the POE is in appendix B.

[4] Major General Julian Thompson, RM (Rtd), "Expeditionary Forces and Expeditionary Warfare: Major Themes and Issues," in *Battles Near and Far: A century of overseas deployment, 2004 Chief of Army History Conference* (Canberra, ACT: Australian Army History Unit, 2005), 6. In his keynote address to the 2004 Chief of Army History Conference, Major General Thompson defined Expeditionary Operations as:

> *A military operation that can be initiated at short notice, consisting of forward* ***deployed or rapidly deployable, self-supporting forces tailored*** *to achieve a* ***clearly stated objective*** *in a* ***foreign country.*** [Original emphasis shown]

[5] Australian Government, *Defence White Paper 2009*, 51-52.

[6] Australian Defence Force, *AAC*, 3. Australian Defence Doctrine Publication (ADDP) 3.2 *Amphibious Operations* defines Amphibious Operations as:

> *A military operation launched from the sea by a naval and landing force embarked in ships, landing craft or rotary wing aircraft, with the principal purpose of projecting the landing force ashore tactically into an environment ranging from permissive to hostile.*

[7] John A. Lejeune, 'The Engineer Battalion of the Marine Corps', *Leatherneck Magazine*, August 1928, 4, http://proquest.umi.com/.

[8] Sapper is an Australian and British Army engineer rank, equivalent to a Private.

[9] Ronald Ramsay McNicoll, *The Royal Australian Engineers 1902 to 1919: The Second Volume of the History of the Royal Australian Engineers* (Riverwood, NSW: Ligare Pty. Ltd, 1979), 27.

[10] Australian Defence Force, *Amphibious Deployment and Sustainment System, Landing Force Concept for Employment v2.0* (U) (Canberra, ACT: Joint Amphibious Capability Implementation Team, March 2010). Cited hereafter as Australian Defence Force, *Landing Force CONEMP*.

[11] Australian Defence Force, *AAC*, 3. The ADF doctrine is ADDP 3.2 *Amphibious Operations* and ADFP 3.2.1 *Amphibious Operations Procedures*.

[12] Australian Defence Force, *AAC*, 6.

[13] Australian Defence Force, *AAC*, 7.

[14] Australian Defence Force, *AAC*, 10.

[15] Australian Defence Force, *AAC*, 8, 13-14.

[16] Australian Defence Force, *AAC*, 14.

[17] Australian Defence Force, *Landing Force CONEMP*, 7.

[18] Australian Defence Force, *Amphibious Deployment and Sustainment System, Logistics Concept for Employment v2.0* (R) (Canberra, ACT: Joint Amphibious Capability Implementation Team, March 2010), 4.

[19] Official records of the Marine Corps' 1st Division in Gape Gloucester, V Amphibious Corps on Saipan, and various RAE units in New Guinea and Borneo are cited below.

[20] "Special Action Report, Cape Gloucester Operation, Vol II", December 1943, Headquarters, First Marine Division, Archives and Special Collections Branch, Library of the Marine Corps, Cape Gloucester Collection, Box 4, Folder 1, 10. Cited hereafter as Headquarters, First Marine Division, "Cape Gloucester Operation."

[21] Headquarters, First Marine Division, "Cape Gloucester Operation;" "Northern Troops and Landing Force Operations Report Phase I (SAIPAN)", August 12, 1944, Headquarters, Northern Troops and Landing Force, Archives and Special Collections Branch, Library of the Marine Corps, WWII Marianas Islands Collection, Box 4, Folder 2; and Ronald Ramsay McNicoll, *The Royal Australian Engineers 1919 to 1945: The Third Volume of the History of the Royal Australian Engineers* (Riverwood, NSW: Ligare Pty. Ltd, 1982).

[22] Major General Julian Thompson, RM (Rtd), *No Picnic* (York, UK: Pen & Sword Books Ltd, 1992), 5-6 and 18. Cited hereafter as Thompson, *No Picnic*.

[23] Major General Nick Vaux, RM (Rtd), *Take That Hill: Royal Marines in the Falklands War* (New York, NY: Brassey's (US) Inc., 1990); Michael Clapp and Ewen Southby-Tailyour, *Amphibious Assault Falklands: The Battle of San Carlos Water* (Barnsley, UK: Pen & Sword Military, 2007); and Ministry of Defence, Director of Public Relations (Army), *The British Army in the Falklands, 1982* (London, UK: Her Majesty's Stationery Office, 1983), 13.

[24] Thompson, *No Picnic*, 104.

[25] "Command Chronology for the Period 4 February to 30 June 1993", July 15, 1993, 1st Combat Engineer Battalion, Archives and Special Collections Branch, Library of the Marine Corps, Command Chronology Collection Box 1482, Folders 9 and 10.

[26] Center of Military History, United States Army, *United States Forces, Somalia After Action Report* (Washington, D.C.: Center of Military History, United States Army, 2003), 252.

[27] "Command Chronology for the Period 27 October 2001 to 26 February 2002", March 2002, Task Force 58, Archives and Special Collections Branch, Library of the Marine Corps, Command Chronology Collection Box 2226, Folder 1; "Command Chronology for the Period 1 July 2001 to 31 December 2001", March 2, 2002, 15th Marine Expeditionary Unit, Archives and Special Collections Branch, Library of the Marine Corps, Command Chronology Collection Box 2205, Folder 4; and "Command Chronology for the Period 1 July 2001 to 28 February 2002", May 31, 2002, 26th Marine Expeditionary Unit, Archives and Special Collections Branch, Library of the Marine Corps, Command Chronology Collection Box 2226, Folders 6 and 7.

[28] 1st Combat Engineer Regiment, *Plan READY ASSIST – 1 CER Support to HA/DR Operations (DRAFT)* (R), (Darwin, NT: 1st Combat Engineer Regiment, July 2010), 1.

[29] Headquarters U.S. Marine Corps, *Seabee Operations in the MAGTF*, MCWP 4-11.5, (Washington DC: Headquarters U.S. Marine Corps, November 1997), 1-33 to 1-41 and 2-10; Lieutenant Colonel Jeffrey Miller, USMC Engineer, email messages to author, November 14,

2010 and January 11, 2011; and Major Taylor White, USMC Engineer, email message to author, January 20, 2011.

[30] Marine Corps Combat Development Command, "2024 Baseline MEB and MEU" (information brief, Marine Corps Combat Development Command, Quantico, VA, January 7, 2010).

[31] Development, Concepts and Doctrine Centre, *Littoral Manoeuvre (Amphibious Task Group) Joint Capability Concept* (Shrivenham, UK: Development, Concepts and Doctrine Centre, June 30, 2009), A-3 to A-4. Cited hereafter as Development, Concepts and Doctrine Centre, *Littoral Manoeuvre Concept.* The British Army, as well as the armies of most Commonwealth nations, including Australia, use the term Regiment to designate a tactical battalion-size unit in the corps of Engineers, Armour, Aviation, Artillery, and Signals. The term Regiment is also used by Australian Special Forces for their battalion-size units – the Special Air Service Regiment (SASR) and the two Commando Regiments – as well as for the grouping of all regular Australian infantry battalions (the Royal Australian Regiment). The term Squadron, historically a company-size Cavalry formation, is used by Commonwealth armies for company-size tactical units in the corps of Engineers, Armour, Aviation, Signals, and Transport, as well as by the SASR.

[32] Captain Ben Simpson, RE, HQ 24 Commando Engineer Regiment, email message to author, January 19, 2011.

[33] Australian Army, Combine Arms Training Centre, *Employment of Engineers*, LWD 3-6-1 (Puckapunyal, VIC: Land Warfare Development Centre, October 16, 2007), 2-5. Cited hereafter as Australian Army, *Employment of Engineers*.

[34] Results of these studies are reported in: Australian Army Headquarters, *Adaptive Campaigning – Army's Future Land Operating Concept* (Canberra, ACT: Australian Army Headquarters, September 2009), Cited hereafter as Australian Army Headquarters, *Adaptive Campaigning*; Australian Defence Force, *Joint Operations for the 21st Century* (Canberra, ACT: Australian Defence Force, May 2007), Cited hereafter as Australian Defence Force, *Joint Operations for the 21st Century*; Development, Concepts and Doctrine Centre, *Littoral Manoeuvre Concept*; and Headquarters United States Joint Forces Command, *The Joint Operating Environment 2010* (Norfolk, VA: Headquarters United States Joint Forces Command, February 18, 2010), Cited hereafter as HQ USJFCOM, *The JOE 2010.*

[35] Williamson Murray, co-author of *The JOE 2010*, comment in USMC Command and Staff College: Elective "Red Teaming" Seminar, January 24, 2011.

[36] Australian Government, *Defence White Paper 2009*, 21.

[37] Australian Defence Force, *Joint Operations for the 21st Century*, 4.

[38] Australian Army Headquarters, *Adaptive Campaigning*, 12.

[39] Australian Army Headquarters, *Adaptive Campaigning*, 14.

[40] Australian Defence Force, *Joint Operations for the 21st Century*, 6.

[41] Australian Army Headquarters, *Adaptive Campaigning*, 12.

[42] Headquarters U.S. Marine Corps, *Marine Corps Vision & Strategy 2025* (Washington DC: Headquarters U.S. Marine Corps, June 18, 2008), 21-22.

[43] For more information about Hybrid Wars and the 2006 Israel-Lebanon conflict, see: Frank G. Hoffman, *Conflict in the 21st Century: The Rise of Hybrid Wars* (Arlington, VA: Potomac Institute for Policy Studies, December 2007), http://www.potomacinstitute.org/images/stories/publications/potomac_hybridwar_0108.pdf; and Colonel Steven C. Williamson, USA, "From Fourth Generation Warfare to Hybrid War"

(Master's thesis, U.S. Army War College, 2009), http://www.dtic.mil/cgi-bin/GetTRDoc?AD=ADA498391&Location=U2.

[44] Defence Science and Technology Organisation, *Mission Area Analysis: Army's Amphibious System Requirements to Conduct Entry from Air and Sea (U)*, DSTO-RR-0277 (Adelaide, SA: July 2004), 11.

[45] Australian Army Headquarters, *Adaptive Campaigning*, 66.

[46] Headquarters U.S. Marine Corps, *Engineering Operations*, MCWP 3-17 (Washington DC: Headquarters U.S. Marine Corps, February 14, 2000), 1-1.

[47] Australian Army, *Employment of Engineers*, 10-5.

[48] Australian Defence Force, *ADAS_Load_Planner_(post_ACMC_LF_Sumbission)*, Microsoft Excel Program (Canberra, ACT: Joint Amphibious Capability Implementation Team, March 2010). Cited hereafter as Australian Defence Force, *ADAS_Load_Planner*.

[49] Australian Defence Force, *ADAS_Load_Planner*.

[50] Australian Army, *Employment of Engineers*, 1-1.

[51] Australian Army, *Employment of Engineers*, 1-8. The seven principles governing the employment of engineers are: Centralised Control with Decentralised Execution, Early Warning and Reconnaissance, Priority of Work, Concentration of Effort, Continuity of Effort, Economy of Effort, and Protection.

[52] Australian Army, *Employment of Engineers*, 1-9.

[53] Australian Army, *Employment of Engineers*, 1-10.

[54] Australian Army, *Employment of Engineers*, 10-5.

[55] Australian Army Headquarters, *Army Capability Requirement: The Modular Engineer Force* (Canberra, ACT: Australian Army Headquarters, May 15, 2009), 4-2.

[56] An Explosive Detection Dog team consists of a Handler and an Explosive Detection Dog.

[57] Australian Government, *Defence White Paper 2009*, 75.

[58] Australian Defence Force, *Landing Force CONEMP*, 7.

APPENDIX A

Acronyms

A2AD ..... Anti-Access and Area-Denial
AAC ..... Australia's Amphibious Concept
ABV ..... Assault Breacher Vehicle
ACE ..... Air Combat Element (MAGTF)
AC-FLOC ..... Adaptive Campaigning – Future Land Operating Concept
ACR ..... Air Crash Rescue
ADF ..... Australian Defence Force
APC ..... Armoured Personnel Carrier
APOD ..... Air Point of Disembarkation
ARE ..... Amphibious Ready Element (Company Group)
ARG ..... Amphibious Ready Group (Battalion Group)
ATF ..... Amphibious Task Force
AVLB ..... Armoured Vehicle Launched Bridge
AWD ..... Army Work Diver

BG ..... Battle Group (Battalion-size)
BDE ..... Brigade

CBIST ..... Chemical Biological Inspection Site Team
CBRNE ..... Chemical, Biological, Radiological, Nuclear, and Explosive
CDO ..... Commando
CE ..... Command Element (MAGTF)
CEB ..... Combat Engineer Battalion (USMC)
CER ..... Combat Engineer Regiment (RAE)
CLB ..... Combat Logistics Battalion
CONEMP ..... Concept of Employment
CSS ..... Combat Service Support
CT ..... Combat Team (Company-size)
CTF ..... Combined Task Force

DACC ..... Defence Aid to the Civil Community
DFACA ..... Defence Force Aid to Civil Authorities
DM ..... Distributed Manoeuvre
DR ..... Disaster Relief
DSO ..... Dive Supervising Officer
DSTO ..... Defence Science and Technology Organisation

EDD ..... Explosive Detection Dog
EOD ..... Explosive Ordnance Disposal
ESB ..... Engineer Support Battalion (USMC)
ESR ..... Engineer Support Regiment (equivalent to ESB)

FARP ..... Forward Arming and Refuelling Point
FASOC ..... Future Air and Space Operating Concept
FJOC ..... Future Joint Operational Concept
FMOC ..... Future Maritime Operating Concept
FSOC ..... Future Special Operations Concept

GCE ..... Ground Combat Element (MAGTF)
Geotech ..... Geospatial Technician

HA ..... Humanitarian Assistance
HAZMAT ..... Hazardous Materials
HLZ ..... Helicopter Landing Zone
HQJOC ..... Headquarters Joint Operations Command (ADF)

IDP ..... Internally Displaced Person
IED ..... Improvised Explosive Device
ISR ..... Intelligence, Surveillance, and Reconnaissance
ISTAR ..... Intelligence, Surveillance, Target Acquisition, and Reconnaissance

JACIT ..... Joint Amphibious Capability Implementation Team
JFAO ..... Joint Force Area of Operations
JTF ..... Joint Task Force

LCE ..... Logistics Combat Element (MAGTF)
LF ..... Landing Force
LHD ..... Landing Helicopter Dock (Ship)
LNO ..... Liaison Officer
LOC ..... Line of Communications
LPD ..... Landing Platform Dock (Ship)
LSD ..... Landing Ship Dock
LSL ..... Landing Ship Logistic
LZ ..... Landing Zone

MAGTF ..... Marine Air Ground Task Force
MEB ..... Marine Expeditionary Brigade
MEF ..... Marine Expeditionary Force
MEU ..... Marine Expeditionary Unit
MPVC ..... Mine Protected Clearance Vehicle
MWSS ..... Marine Wing Support Squadron

NBC ..... Nuclear Biological Chemical
NCF ..... Naval Construction Force (US Navy Seabees)
NEO ..... Non-combatant Evacuation Operation
NGO ..... Non-Government Organisations
NMCB ..... Naval Mobile Construction Battalion

OMFTS ..... Operational Manoeuvre from the Sea (USMC)
OTH ..... Over-the-Horizon

PHCT ..... Primary Health Care Team
PMV ..... Protected Mobility Vehicle
POE ..... Primary Operating Environment
RAAF ..... Royal Australian Air Force
RAE ..... Royal Australian Engineers
RAF ..... Royal Air Force
RAN ..... Royal Australian Navy
RCT ..... Ready Combat Team
RE ..... Royal Engineer
RM ..... Royal Marine
RN ..... Royal Navy
ROWPU ..... Reverse Osmosis Water Purification Unit

SOF ..... Special Operations Forces
SPMAGTF ..... Special Purpose Marine Air Ground Task Force
SPOD ..... Sea Point of Disembarkation
STOM ..... Ship-to-Objective Manoeuvre

TF ..... Task Force

UK ..... United Kingdom of Great Britain & Northern Ireland
UN ..... United Nations
US ..... United States of America
USN ..... United States Navy
USMC ..... United States Marine Corps
UXO ..... Unexploded Ordnance

VSTOL ..... Vertical/Short Take-Off and Landing

WP09 ..... Australian Defence White Paper 2009

APPENDIX B

Australia's Primary Operating Environment

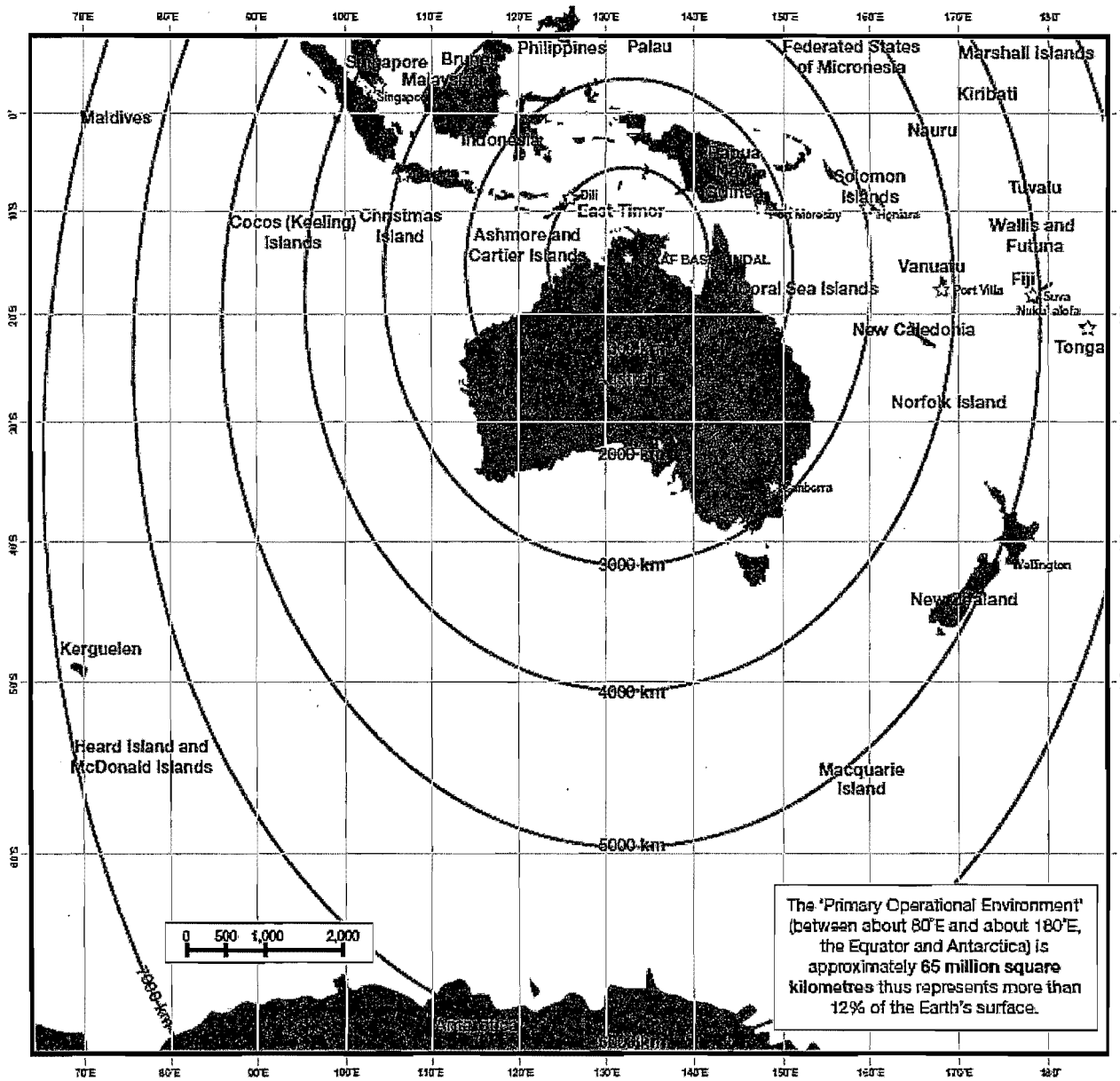

Figure 9. Australia's Primary Operating Environment (POE)

Source: Australian Army Headquarters. *Adaptive Campaigning – Army's Future Land Operating Concept.* Canberra, ACT: Australian Army Headquarters, September 2009.

APPENDIX C

Royal Australian Navy Canberra Class Landing Helicopter Dock Ship

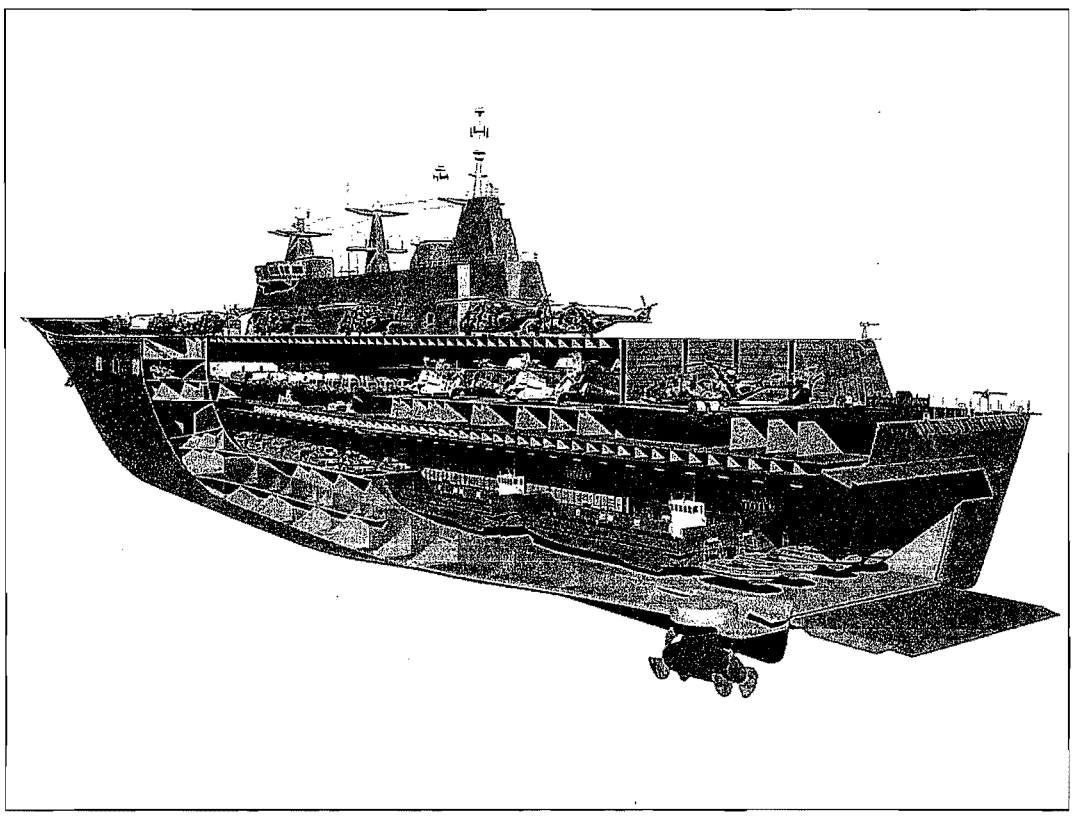

Figure 10. Cutaway Drawing of Canberra Class Landing Helicopter Dock (LHD) Ship

Constructed by	Hull - Navantia (Spain); Superstructure - BAE Systems Australia Defence (BAESAD)
Complement	243
Embarked forces	978
Accommodation	1403
Length overall	230.8 metres
Full load draft	7.148 metres
Full load displacement	27,851 tonnes
Maximum speed	20.5 knots
Vehicle capacity	830 lane metres (3,290 m^2)
Aviation	8 x MRH90 or Tiger Armed Reconnaissance Helicopters (ARH) Can operate CH-47 Chinook helicopters
Medical capacity	2 x operating theatres, high/medium/low dependency

Table 2. Specifications for the Canberra Class LHD Ship

Source: Defence Materiel Organisation, JP 2048 Phase 4A/B, http://www.defence.gov.au/dmo/msd/jp2048/jp2048ph4AB.cfm.

Note. The model for the proposed Landing Ship Dock (LSD) has yet to be chosen by the ADF.

APPENDIX D

Historical Tasks Undertaken by Amphibious Engineers

The following tasks, by functional area of engineering support, have been conducted by amphibious engineers (including pioneers) from the USMC, RAE, and RE during the first 30 days (from D to D+30) of select amphibious operations since 1943. The last four columns in the tables show which engineer organization conducted the tasks: Combat Engineer Battalion (**CEB**)/Regiment (**CER**); Engineer Support Battalion (**ESB**)/Regiment (**ESR**); Marine Wing Support Squadron (**MWSS**); or Naval Construction Force (**NCF**).

The tasks from the Second World War (from 1943 onward) are relevant because they were conducted in the primary operational environment specified for the ADF in *Australia's Amphibious Concept*. The tasks listed are only those tasks currently conducted by RAE units.

Second World War – Cape Gloucester (New Guinea) Operations, USMC, 1943

Task – by functional area	**CEB / CER**	**ESB / ESR**	**MWSS Det**	**NCF**
General				
Fight as infantry	X	X		
Conduct defensive operations	X	X		
Mobility				
Construct/improve beach exits	X			
Construct/improve pioneer tracks	X			
Expediently maintain tracks	X			
Construct corduroy roads	X			
Construct expedient bridges	X			
Clear mines	X			
Conduct EO clearance (UXO, IED & booby traps)	X			
Reduce enemy obstacles and barriers	X			
Counter-Mobility				
Plan/install obstacles and barriers	X			
Survivability				
No reported tasks				
General Engineering / Sustainability				
Construct hardstands and dump areas	X			
Clearing of bivouac/camp areas	X			
Construct/improve road (incl culverts)	X	X		
Maintain roads	X	X		
Water supply	X	X		
Unloading of amphibious watercraft	X	X		

Table 3. 1st Marine Division Engineer Tasks, December 1943

Source: Headquarters, First Marine Division, "Special Action Report, Cape Gloucester Operation, Vol II," Archives and Special Collections Branch, Library of the Marine Corps, Cape Gloucester Collection, Box 4, Folder 1.

Second World War – Saipan (Marianas), USMC and US Army, 1944

Task – by functional area	CEB / CER	ESB / ESR	MWSS Det	NCF
General				
Fight as infantry	X			X
Conduct defensive operations	X			X
Mobility				
Construct/improve beach exits	X			
Construct/improve pioneer tracks	X			
Construct corduroy roads	X			
Conduct EO clearance (UXO, IED & booby traps)	X			
Reduce enemy obstacles and barriers	X			
Reduce enemy fortifications and bunkers	X			
Counter-Mobility				
No reported tasks				
Survivability				
No reported tasks				
General Engineering / Sustainability				
Construct hardstands and dump areas	X			X
Construct/improve road (incl culverts)				X
Maintain roads				X
Build expedient airfields				X
Water supply				X
Unloading of amphibious watercraft	X			
Railway repair				X

Table 4. V Amphibious Corps Engineer Tasks, August 1944

Source: Headquarters, Northern Troops and Landing Force, "Northern Troops and Landing Force Operations Report Phase I (SAIPAN)," Archives and Special Collections Branch, Library of the Marine Corps, WWII Marianas Islands Collection, Box 4, Folder 2.

Second World War – New Guinea and Borneo Operations (Lae, Madang, Wewak, Borneo, Tarakan, Balikpapan), Royal Australian Engineers, 1943-1945

Task – by functional area	CEB / CER	ESB / ESR	MWSS Det	NCF
General				
Fight as infantry	X			
Conduct defensive operations	X	X		
Mobility				
Reduce obstacles below the high tide mark	X			
Construct/improve beach exits	X			
Conduct route reconnaissance (incl bridges)	X			
Construct/improve pioneer tracks	X			
Expediently maintain tracks	X			
Construct corduroy roads	X			

Construct expedient bridges	X			
Clear mines	X			
Conduct EO clearance (UXO, IED & booby traps)	X			
Conduct route clearance (mines, IED & booby traps)	X			
Reduce enemy obstacles and barriers	X			
Reduce enemy fortifications and bunkers	X			
Operate rafts and ferries	X			
Construct Landing Zones	X			
Counter-Mobility				
Plan/install obstacles and barriers	X			
Survivability				
Construct fighting positions	X			
Construct Command Posts (CPs)/First Aid Stations	X			
General Engineering / Sustainability				
Construct hardstands and dump areas	X	X		
Establish maintenance areas		X		
Clearing of bivouac/camp areas	X	X		
Construct semi-permanent camps		X		
Construct/improve road (incl culverts)	X	X		
Maintain roads		X		
Repair airfield damage	X			
Build expedient airfields	X			
Water supply	X	X		
Unloading of amphibious watercraft	X	X		
Construction/repair of a pier		X		

Table 5. Royal Australian Engineer Tasks, New Guinea and Borneo, 1943-1945

Source: McNicoll, Ronald Ramsay. *The Royal Australian Engineers 1919 to 1945: The third volume of the history of the Royal Australian Engineer*. Riverwood, NSW: Ligare Pty. Ltd, 1982.

Operation CORPORATE, Falkland Islands, Royal Engineers as part of 3 Commando Brigade, Royal Marines and 5th Infantry Brigade, 1982

Task – by functional area	CEB / CER	ESB / ESR	MWSS Det	NCF
General				
Fight as infantry	X			
Conduct defensive operations	X			
Geospatial				
Produce paper and digital terrain maps		X		
Mobility				
Construct/improve beach exits	X			
Construct/repair expedient bridges	X			
Minefield reconnaissance	X			
Clear mines	X			
Conduct EO clearance (UXO, IED & booby traps)	X	X		
Conduct route clearance (mines, IED & booby traps)	X			

Engineer search tasks (caches, areas & buildings)	X			
Destroy enemy equipment	X			
Reduce enemy obstacles and barriers	X	X		
Counter-Mobility				
Plan/install obstacles and barriers	X			
Survivability				
Construct fighting positions	X	X		
Construct strong points	X	X		
Construct Command Posts (CPs) / First Aid Stations	X	X		
General Engineering / Sustainability				
Construct hardstands and dump areas		X		
Construct semi-permanent camps		X		
Construct showers and ablutions		X		
Construct Field Hospital		X		
Install power distribution system		X		
Repair airfield damage		X		
Improve airfields (extend & construct aprons)		X		
Construct VSTOL pad		X		
Construct FARP		X		
Construct fuel pumping system (incl pipeline)		X		
Water supply	X	X		
Unloading of amphibious watercraft	X	X		

Table 6. Royal Engineer Tasks, Falklands Islands, May-June 1982

Sources:

Freedman, Sir Lawrence. *The Official History of the Falklands Campaign, Vol. II: War and Diplomacy.* Abingdon UK: Taylor & Francis Books Inc., 2006.

Ministry of Defence, Director of Public Relations (Army). *The British Army in the Falklands, 1982.* London, UK: Her Majesty's Stationery Office, 1983.

Thompson, Major General Julian, RM (Rtd). *No Picnic.* York, UK: Pen & Sword Books Ltd, 1992.

Vaux, Major General Nick, RM (Rtd). *Take That Hill: Royal Marines in the Falklands War.* New York, NY: Brassey's (US) Inc., 1990.

Operation RESTORE HOPE, Somalia, USMC, December 1992 - January 1993

Task – by functional area	CEB / CER	ESB / ESR	MWSS Det	NCF
General				
Fight as infantry	X			
Conduct defensive operations	X	X	X	X
Mobility				
Construct/improve beach exits				
Conduct route reconnaissance (incl bridges)	X	X		X
Clear mines	X	X		
Conduct EO clearance (UXO, IED & booby traps)		X		
Conduct route clearance (mines, IED & booby traps)	X			
Engineer search tasks (caches, areas & buildings)	X			

Reduce enemy obstacles and barriers	X			
Construct Helicopter Landing Zones	X			
Counter-Mobility				
Plan/install obstacles and barriers	X			
Survivability				
Construct fighting positions	X			
Construct strong points	X			
Construct vehicle check points (VCPs)	X			
Construct Command Posts (CPs) / First Aid Stations				X
Harden buildings and facilities	X	X		
Construct FOB perimeter walls	X			
Air Crash Rescue			X	
General Engineering / Sustainability				
Construct hardstands and dump areas	X	X		
Establish maintenance areas	X			
Clearing of bivouac/camp areas	X	X		
Construct semi-permanent camps	X	X		X
Construct showers and ablutions	X	X		X
Construct Field Hospital				X
Construct furniture				X
Install power distribution system	X	X		X
Construct/improve road (incl culverts)	X	X		
Maintain roads	X	X		X
Remove rubbish/debris from routes		X		X
Repair airfield damage	X			
Build expedient airfields	X			X
Improve airfields (extend & construct aprons)				X
Construct VSTOL pad				X
Construct FARP			X	
Construct fuel pumping system (incl pipeline)		X	X	X
Water point reconnaissance		X		
Water supply	X	X		X
Unloading of amphibious watercraft		X		
Construct/repair SPOD	X	X		X

Table 7. 1st Combat Engineer Battalion Engineer Tasks, Somalia, December 1992 - January 1993

Source: 1st Combat Engineer Battalion, "Command Chronology for the Period 4 February to 30 June 1993," Archives and Special Collections Branch, Library of the Marine Corps, Command Chronology Collection Box 1482, Folders 9 and 10.

Non-combatant Evacuation Operation (Not Executed), World Trade Organization Meeting in Qatar, USMC, 7-13 November 2001

Task – by functional area	CEB / CER	ESB / ESR	MWSS Det	NCF
General				
Conduct defensive operations		X		
Mobility				
Conduct EO clearance (UXO, IED & booby traps)		X		
Engineer search tasks (caches, areas & buildings)		X		
Engineer search tasks (personnel & vehicles)		X		
Counter-Mobility				
No reported tasks				
Survivability				
Construct strong points		X		
Construct vehicle check points (VCPs)		X		
Conduct CBRN decontamination		X		
General Engineering / Sustainability				
No reported tasks				

Table 8. 15th MEU Engineer Tasks, Planned NEO for World Trade Organization Meeting in Qatar, 7-13 November 2001

Sources:

15th Marine Expeditionary Unit, "Command Chronology for the Period 1 July 2001 to 31 December 2001," Archives and Special Collections Branch, Library of the Marine Corps, Command Chronology Collection Box 2205, Folder 4.

MEU Service Support Group 15, "Command Chronology for the Period 1 July 2001 to 31 December 2001," Archives and Special Collections Branch, Library of the Marine Corps, Command Chronology Collection Box 2205, Folder 4.

Operation ENDURING FREEDOM, Afghanistan, Task Force 58 Seizure of FOB Rhino and Kandahar Airport, November 2001 – January 2002

Task – by functional area	CEB / CER	ESB / ESR	MWSS Det	NCF
General				
Fight as infantry	X			
Conduct defensive operations	X	X		
Mobility				
Conduct route reconnaissance (incl bridges)	X			
Clear mines	X	X		
Conduct EO clearance (UXO, IED & booby traps)		X		
Provide technical intelligence on enemy ordnance		X		
Conduct route clearance (mines, IED & booby traps)		X		
Engineer search tasks (caches, areas & buildings)		X		
Engineer search tasks (personnel & vehicles)		X		
Reduce enemy obstacles and barriers	X			

Reduce enemy fortifications and bunkers	X			
Construct Helicopter Landing Zones	X	X		
Airfield assessment – capacity				X
Counter-Mobility				
Plan/install obstacles and barriers	X	X		X
Plan/install tactical obstacles	X	X		X
Survivability				
Construct fighting positions	X	X		
Construct strong points	X	X		
Construct vehicle check points (VCPs)	X	X		
Construct Command Posts (CPs) / First Aid Stations		X		
Harden buildings and facilities	X	X		X
Construct FOB perimeter walls	X	X		X
Construct protective berms		X		X
Air Crash Rescue			X	
CBRNE operations (site exploitation)		X		
General Engineering / Sustainability				
Clearing of bivouac/camp areas		X		
Construct semi-permanent camps		X		
Construct showers and ablutions		X		X
Construct Field Hospital (Level II)		X		X
Construct detainee compound	X	X		X
Install power distribution system		X		
Waste management		X		
Construct/improve road (incl culverts)		X		
Maintain roads		X		
Airfield reconnaissance/assessment		X		X
Repair airfield damage		X		X
Improve airfields (extend & construct aprons)		X		X
Maintain airfields (24h operations)				X
Construct FARP		X		
Construct fuel pumping system (incl pipeline)		X		
Water supply		X		

Table 9. TF 58 (15th MEU, 26th MEU, and NMCB 133) Engineer Tasks, APOD Seizures in Afghanistan, November 2001 - January 2002

Sources:

Task Force 58, "Task Force 58 Command Chronology for the Period 27 October 2001 to 26 February 2002," Archives and Special Collections Branch, Library of the Marine Corps, Command Chronology Collection Box 2226, Folder 1.

15th Marine Expeditionary Unit, "Command Chronology for the Period 1 July 2001 to 31 December 2001," Archives and Special Collections Branch, Library of the Marine Corps, Command Chronology Collection Box 2205, Folder 4.

MEU Service Support Group 15, "Command Chronology for the Period 1 July 2001 to 31 December 2001," Archives and Special Collections Branch, Library of the Marine Corps, Command Chronology Collection Box 2205, Folder 4.

26th Marine Expeditionary Unit, "Command Chronology for the Period 1 July 2001 to 28 February 2002," Archives and Special Collections Branch, Library of the Marine Corps, Command Chronology Collection Box 2226, Folders 6 and 7.

MEU Service Support Group 26, "Command Chronology for the Period 1 July 2001 to 28 February 2002," Archives and Special Collections Branch, Library of the Marine Corps, Command Chronology Collection Box 2226, Folder 4.

Humanitarian Assistance and Disaster Relief Operations, Indonesia, Royal Australian Engineers, 2004-2005 and 2009

Task – by functional area	CEB / CER	ESB / ESR	MWSS Det	NCF
Geospatial				
Produce paper and digital terrain maps		X		
Mobility				
Reduce obstacles below the high tide mark	X			
Construct/improve beach exits	X			
Conduct route reconnaissance (incl bridges)	X			
Construct/improve pioneer tracks	X			
Expediently maintain tracks	X			
Construct corduroy roads	X			
Construct expedient bridges	X			
Construct Helicopter Landing Zones	X			
Counter-Mobility				
No reported tasks				
Survivability				
HAZMAT removal and decontamination	X			
Air Crash Rescue	X			
General Engineering / Sustainability				
Construct hardstands and dump areas	X			
Establish maintenance areas	X			
Clearing of bivouac/camp areas	X			
Construct semi-permanent camps	X			
Construct showers and ablutions	X			
Construct Field Hospital	X			
Construct Internally Displaced Persons (IDP) camp	X			
Structural assessment of damaged buildings	X	X		
Demolition of damaged buildings	X			
Render safe buildings (structural and electrical)	X			
Install power distribution system	X			
Construct/improve road (incl culverts)	X			
Maintain roads	X			
Construct/repair drainage	X			
Remove rubbish/debris from routes	X			
Repair airfield damage	X			

Water point reconnaissance	X			
Water supply	X			
Recovery and temporary burial of dead bodies	X			
Construct/repair SPOD	X			

Table 10. 1st Combat Engineer Regiment Engineer Tasks, Operations SUMATRA ASSIST (December 2004 - March 2005) and PADANG ASSIST (October - November 2009)

Sources:

1st Combat Engineer Regiment. *1 CER Post Operational Report – Op SUMATRA* ASSIST. Darwin, NT: 1st Combat Engineer Regiment, June 2005. (Author's possession)

1st Combat Engineer Regiment. *Plan READY ASSIST – 1 CER Support to HA/DR Operations (DRAFT).* Darwin, NT: 1st Combat Engineer Regiment, July 2010. (Author's possession)

1st Field Squadron. *Post Operational Report – 1 FD SQN GP – Operation PADANG ASSIST.* Padang Sago, Indonesia: Headquarters 1st Field Squadron Group, October 31, 2009. (Author's possession)

APPENDIX E

Existing Organisations for Engineer Support to Amphibious Operations

The following tables contain the manning and equipment lists for previous and current amphibious engineer elements that support battalion-size Battle Groups, such as a USMC Marine Expeditionary Unit (MEU). While **template or doctrinal orders** of battle exist, more often than not they are **modified** because of personnel and equipment availability, or they are **tailored** for a specific mission. The tables below show all personnel included in identifiable engineer formations as well as individuals who provided specialisations that are currently provided by Royal Australian Engineers. An * denotes the Royal Australian Engineer specialisations. Specialisations that would not have been included in a likely Royal Australian Engineer element, such as Bulk Fuel Specialists, have been excluded.

Current II MEF Engineer Support to a MEU

Total manning: 7 Officers and 96 Enlisted (Total personnel – 103)
Manning for specialisations provided by Royal Australian Engineers: 5 Officers and 82 Enlisted

Position No.	Billet Description	Rank	Grade	MOS
Command Element (2:1, Officers : Enlisted)				
1*	Engineer Liaison Officer	MAJ	O4	
2*	NCF Liaison Officer (US Navy)	LCDR	O4	
3*	Engineer Chief	MSGT	E8	
Ground Combat Element (Combat Engineer Platoon, Reinforced, 1:40)				
4*	Platoon Commander	1LT	O2	1302
5*	Platoon Sergeant	GYSGT	E7	1371
6*	Platoon Guide	SSGT	E6	1371
7*	Combat Engineer	PVT	E1-E2	1371
8*	Radio Operator	LCPL	E3	0621
9*	Engineer Equipment Operator (Plant Operator)	LCPL	E3	1345
10*	Engineer Equipment Operator (Plant Operator)	LCPL	E3	1345
11*	Engineer Equipment Operator (Plant Operator)	LCPL	E3	1345
12	Engineer Equipment Mechanic	SGT	E5	1341
13*	Heavy Vehicle Operator	LCPL	E3	3531
14*	Heavy Vehicle Operator	LCPL	E3	3531
15*	Squad Leader	SGT	E5	1371
16*	Team Leader	CPL	E4	1371
17*	Team Leader	CPL	E4	1371
18*	Combat Engineer	LCPL	E3	1371
19*	Combat Engineer	LCPL	E3	1371
20*	Combat Engineer	LCPL	E3	1371
21*	Combat Engineer	PVT	E1-E2	1371
22*	Combat Engineer	PVT	E1-E2	1371
23*	Combat Engineer	PVT	E1-E2	1371
24*	Squad Leader	SGT	E5	1371
25*	Team Leader	CPL	E4	1371
26*	Team Leader	CPL	E4	1371

27*	Combat Engineer	LCPL	E3	1371
28*	Combat Engineer	LCPL	E3	1371
29*	Combat Engineer	LCPL	E3	1371
30*	Combat Engineer	PVT	E1-E2	1371
31*	Combat Engineer	PVT	E1-E2	1371
32*	Combat Engineer	PVT	E1-E2	1371
33*	Squad Leader	SGT	E5	1371
34*	Team Leader	CPL	E4	1371
35*	Team Leader	CPL	E4	1371
36*	Combat Engineer	LCPL	E3	1371
37*	Combat Engineer	LCPL	E3	1371
38*	Combat Engineer	LCPL	E3	1371
39*	Combat Engineer	PVT	E1-E2	1371
40*	Combat Engineer	PVT	E1-E2	1371
41*	Combat Engineer	PVT	E1-E2	1371
42*	Electrician	LCPL	E3	1141
43	Food Service Specialist (Cook)	LCPL	E3	3381
44	Corpsman (Medic)	HM	E3	8404
Logistics Combat Element (4:46)				
Headquarters (2:3)				
45*	Future Operation Officer / XO	MAJ	O4	1302
46*	Assistant Operations Officer	1LT	O2	1302
47*	Training NCO / SORTS	SGT	E5	1391
48*	NBC NCO	SGT	E5	5711
49*	HAZMAT NCO	CPL	E4	1391
EOD Section (0:6)				
50*	EOD Section Leader	MSGT	E8	2336
51*	EOD Assistant Section Leader	GYSGT	E7	2336
52*	EOD Technician	SSGT	E6	2336
53*	EOD Technician	SSGT	E6	2336
54*	EOD Technician	SGT	E5	2336
55*	EOD Technician	SGT	E5	2336
Maintenance Platoon (Engineer Equipment and Vehicles) (1:11)				
56	Maintenance Officer	CWO2	W2	3510
57	Maintenance Chief	MSGT	E8	1349
58	Electrical Equipment Repair Specialist	SGT	E5	1142
59	Electrical Equipment Repair Specialist	CPL	E4	1142
60	Electrical Equipment Repair Specialist	LCPL	E3	1142
61	Refrigeration Mechanic	LCPL	E3	1161
62	Metal Worker/Welder	CPL	E4	1316
63	Engineer Equipment Mechanic	SGT	E5	1341
64	Engineer Equipment Mechanic	CPL	E4	1341
65	Engineer Equipment Mechanic	CPL	E4	1341
66	Engineer Equipment Mechanic	LCPL	E3	1341
67	Small Craft Boat Repairer	LCPL	E3	1341
Engineer Platoon (1:26)				
68*	Engineer Officer	1LT	O2	1302
69*	Engineer Chief	GYSGT	E7	1371
70*	Hygiene Equipment Operator (Plumber)	SGT	E5	1171
71*	Hygiene Equipment Operator (Plumber)	CPL	E4	1171

72*	Hygiene Equipment Operator (Plumber)	LCPL	E3	1171
73*	Hygiene Equipment Operator (Plumber)	LCPL	E3	1171
74*	Hygiene Equipment Operator (Plumber)	LCPL	E3	1171
75*	Section Leader (Plant Operator)	SGT	E5	1345
76*	Engineer Equipment Operator (Plant Operator)	LCPL	E3	1345
77*	Engineer Equipment Operator (Plant Operator)	LCPL	E3	1345
78*	Engineer Equipment Operator (Plant Operator)	LCPL	E3	1345
79*	Engineer Equipment Operator (Plant Operator)	LCPL	E3	1345
80*	Engineer Equipment Operator (Plant Operator)	LCPL	E3	1345
81*	Engineer Equipment Operator (Plant Operator)	LCPL	E3	1345
82*	Engineer Equipment Operator (Plant Operator)	LCPL	E3	1345
83*	Combat Engineer Team Leader	SGT	E5	1371
84*	Combat Engineer	CPL	E4	1371
85*	Combat Engineer	CPL	E4	1371
86*	Combat Engineer	CPL	E4	1371
87*	Combat Engineer	LCPL	E3	1371
88*	Combat Engineer	LCPL	E3	1371
89*	Combat Engineer	LCPL	E3	1371
90*	Combat Engineer	LCPL	E3	1371
91*	Electrician	SGT	E5	1141
92*	Electrician	SGT	E5	1141
93*	Electrician	LCPL	E3	1141
94*	Electrician	LCPL	E3	1141
Air Combat Element (Marine Wing Support Squadron (MWSS) Detachment, 0:9)				
95*	Engineer Chief	GYSGT	E7	
96*	Radio Operator	LCPL	E3	0621
97*	Engineer Equipment Operator (Plant Operator)	LCPL	E3	1345
98*	Engineer Equipment Operator (Plant Operator)	LCPL	E3	1345
99*	Expeditionary Airfield Systems Technician	CPL	E4	7011
100*	Expeditionary Airfield Systems Technician	LCPL	E3	7011
101*	Aircraft Rescue and Firefighting Specialist	SGT	E5	7051
102*	Aircraft Rescue and Firefighting Specialist	CPL	E4	7051
103*	Aircraft Rescue and Firefighting Specialist	LCPL	E3	7051

Sub-Unit	Major Equipment Type	Quantity	Remarks
GCE	Assault Breacher Vehicle (ABV)	2	If M1A1 deploy
GCE	M9 Armoured Combat Earthmover (ACE)	2	6.25 LM ea
GCE / LCE	Multi-Terrain Skid-Steer Loader – CAT 277C	1 / 2	3.70 LM ea
LCE	TRAM Wheeled Loader – JD 634K (LX-120 type)	3	7.76 LM ea
GCE / LCE	Armoured Backhoe/Loader – CAT 420D	1 / 1	6.96 LM ea
LCE	Crawler Tractor / Medium Bulldozer – Case 1150	1	5.03 LM ea
GCE	Mine Clearing Launched Trailer	1	
LCE	Trailer Flat Bed	1	
GCE	Dump Trucks – M817 (MK29/MK 30 replacing)	2	
LCE	Tactical Water Purification Unit (WPU)	2	
LCE	Rough Terrain Forklift	1	
LCE	Bath Shower Unit Expeditionary	2	

Table 11. Current Engineer Support to a II MEF MEU

15th MEU Engineers during the period 1 July - 31 Dec 2001 (Seizure of FOB Rhino, OEF)

Total manning: 7 Officers and 101 Enlisted (Total personnel – 108) + 30 US Navy Seabees
Manning for specialisations provided by Royal Australian Engineers: 6 Officers and 86 Enlisted

Note: The Command Chronologies referenced a Combat Engineer Platoon and Command Element engineers; however, specific details were not provided. The Combat Engineer Platoon details are those of the 2nd Platoon, Company A, 2nd Combat Engineer Company who deployed with the 24th MEU in 2002.

Position No.	Billet Description	Rank	Grade	MOS
Command Element (2:1, Officers : Enlisted)				
1*	Engineer Liaison Officer	MAJ	O4	
2*	NCF Liaison Officer (US Navy)	LCDR	O4	
3*	Engineer Chief	MSGT	E8	
Ground Combat Element (Combat Engineer Platoon, Reinforced, 1:45)				
4*	Platoon Commander	1LT	O2	1302
5*	Platoon Sergeant	GYSGT	E7	1371
6*	Platoon Guide	SSGT	E6	1371
7*	Squad Leader	SGT	E5	1371
8*	Team Leader	CPL	E4	1371
9*	Team Leader	CPL	E4	1371
10*	Combat Engineer	LCPL	E3	1371
11*	Combat Engineer	LCPL	E3	1371
12*	Combat Engineer	LCPL	E3	1371
13*	Combat Engineer	PVT	E1-E2	1371
14*	Combat Engineer	PVT	E1-E2	1371
15*	Combat Engineer	PVT	E1-E2	1371
16*	Combat Engineer	PVT	E1-E2	1371
17*	Combat Engineer	PVT	E1-E2	1371
18*	Squad Leader	SGT	E5	1371
19*	Team Leader	CPL	E4	1371
20*	Team Leader	CPL	E4	1371
21*	Combat Engineer	LCPL	E3	1371
22*	Combat Engineer	LCPL	E3	1371
23*	Combat Engineer	LCPL	E3	1371
24*	Combat Engineer	PVT	E1-E2	1371
25*	Combat Engineer	PVT	E1-E2	1371
26*	Combat Engineer	PVT	E1-E2	1371
27*	Combat Engineer	PVT	E1-E2	1371
28*	Combat Engineer	PVT	E1-E2	1371
29*	Squad Leader	SGT	E5	1371
30*	Team Leader	CPL	E4	1371
31*	Team Leader	CPL	E4	1371
32*	Combat Engineer	LCPL	E3	1371
33*	Combat Engineer	LCPL	E3	1371
34*	Combat Engineer	LCPL	E3	1371
35*	Combat Engineer	PVT	E1-E2	1371

36*	Combat Engineer	PVT	E1-E2	1371
37*	Combat Engineer	PVT	E1-E2	1371
38*	Combat Engineer	PVT	E1-E2	1371
39*	Tool Room NCO / Squad Leader	SGT	E5	1371
40*	Heavy Vehicle Operator	LCPL	E3	3531
41*	Heavy Vehicle Operator	LCPL	E3	3531
42*	Engineer Equipment Operator (Plant Operator)	LCPL	E3	1345
43*	Engineer Equipment Operator (Plant Operator)	LCPL	E3	1345
44*	Engineer Equipment Operator (Plant Operator)	LCPL	E3	1345
45	Engineer Equipment Mechanic	SGT	E5	1341
46*	Electrician	LCPL	E3	1141
47*	Radio Operator	LCPL	E3	0621
48	Food Service Specialist (Cook)	LCPL	E3	3381
49	Corpsman (Medic)	HM	E3	8404
Logistics Combat Element (MSSG 15) (1:33)				
Headquarters (2:2)				
50	Commanding Officer (Not filled by Engineer)	LTCOL	O5	4202/1302
51*	XO (Not filled by Engineer)	MAJ	O4	4202/1302
52	Operations Officer (Not filled by Engineer)	MAJ	O4	4202/1302
53*	Asst Operations Officer (Not filled by Engineer)	1LT	O2	4202/1302
54	Operations Chief (Not filled by Engineer)	MSGT	E8	0491/13XX
55*	Training NCO / SORTS	SGT	E5	1371
56*	NBC NCO	SGT	E5	5711
EOD Section (0:8)				
57*	EOD Section Leader	GYSGT	E7	2336
58*	EOD Assistant Section Leader	SSGT	E6	2336
59*	EOD Technician	SGT	E5	2336
60*	EOD Technician	SGT	E5	2336
61*	EOD Technician	SGT	E5	2336
62*	EOD Technician	SGT	E5	2336
63*	EOD Technician (USN)	AO1		
64*	EOD Technician (USN)	ET1		
Maintenance Platoon (Engineer Equipment and Vehicles, 1:10)				
65	Maintenance Officer	CWO2	W2	3510/13XX
66	Maintenance Chief	MSGT	E8	1349
67	Electrical Equipment Repair Specialist	SGT	E5	1142
68	Electrical Equipment Repair Specialist	CPL	E4	1142
69	Refrigeration Mechanic	CPL	E4	1161
70	Metal Worker/Welder	CPL	E4	1316
71	Engineer Equipment Chief	SSGT	E6	1341
72	Engineer Equipment Mechanic	SGT	E5	1341
73	Engineer Equipment Mechanic	CPL	E4	1341
74	Engineer Equipment Mechanic	CPL	E4	1341
75	Engineer Equipment Mechanic	LCPL	E3	1341
Engineer Platoon (1:23)				
76*	Engineer Officer	1LT	O2	1302
77*	Engineer Chief	GYSGT	E7	1349/1391
78*	Hygiene Equipment Operator (Plumber)	SGT	E5	1171
79*	Hygiene Equipment Operator (Plumber)	CPL	E4	1171
80*	Hygiene Equipment Operator (Plumber)	LCPL	E3	1171

81*	Hygiene Equipment Operator (Plumber)	LCPL	E3	1171
82*	Hygiene Equipment Operator (Plumber)	LCPL	E3	1171
83*	Engineer Equipment Chief (Civil Supervisor)	SSGT	E6	1345
84*	Section Leader (Plant Operator)	SGT	E5	1345
85*	Engineer Equipment Operator (Plant Operator)	LCPL	E3	1345
86*	Engineer Equipment Operator (Plant Operator)	LCPL	E3	1345
87*	Engineer Equipment Operator (Plant Operator)	LCPL	E3	1345
88*	Engineer Equipment Operator (Plant Operator)	PFC	E2	1345
89*	Engineer Equipment Operator (Plant Operator)	PFC	E2	1345
90*	Engineer Equipment Operator (Plant Operator)	PFC	E2	1345
91*	Engineer Equipment Operator (Plant Operator)	PFC	E2	1345
92*	Combat Engineer Team Leader	SGT	E5	1371
93*	Combat Engineer	LCPL	E3	1371
94*	Combat Engineer	LCPL	E3	1371
95*	Combat Engineer	LCPL	E3	1371
96*	Combat Engineer	LCPL	E3	1371
97*	Combat Engineer	LCPL	E3	1371
98*	Electrician	SGT	E5	1141
99*	Electrician	LCPL	E3	1141
Air Combat Element (Marine Wing Support Squadron (MWSS) Detachment, 0:9)				
100*	Engineer Chief	GYSGT	E7	
101*	Radio Operator	LCPL	E3	0621
102*	Engineer Equipment Operator (Plant Operator)	LCPL	E3	1345
103*	Engineer Equipment Operator (Plant Operator)	LCPL	E3	1345
104*	Expeditionary Airfield Systems Technician	CPL	E4	7011
105*	Expeditionary Airfield Systems Technician	LCPL	E3	7011
106*	Aircraft Rescue and Firefighting Specialist	SGT	E5	7051
107*	Aircraft Rescue and Firefighting Specialist	CPL	E4	7051
108*	Aircraft Rescue and Firefighting Specialist	LCPL	E3	7051
Seabee Detachment – Naval Mobile Construction Battalion (NMCB) 133 (1:29)				
	Total of 30 – composition unknown			

Table 12. Engineer Support to 15th MEU for Seizure of FOB Rhino in 2001

Commando Squadron, 24th Commando Engineer Regiment, Royal Engineers

Table 13 shows what is expected to support a Royal Marine Commando Battle Group following the British Government's 2010 Strategic Defence and Security Review. A standard Commando Squadron will consist of two field troops, although wargaming in 2010 showed that three field troops are highly desirable. The support engineering element shown is a likely composition; however, the support engineering element will be mission specific.

Total manning: 7 Officers and 119 Enlisted (Total personnel – 126)
Manning for specialisations provided by Royal Australian Engineers: 7 Officers and 116 Enlisted

Position No.	Billet Description	Rank	Grade	Remarks
Squadron Headquarters (2:8, Officers : Enlisted)				
1*	Commander	MAJ	O4	
2*	Second-in-Command (2IC)	CAPT	O3	
3*	Squadron Sergeant Major	WO2	E8	
4*	Orderly Room Clerk	CPL	E5	
5	Signaller	CPL	E5	
6*	Signaller	SPR	E2	
7*	Driver	SPR	E2	
8*	Driver	SPR	E2	
9*	Squadron Quartermaster Sergeant	SSGT	E7	
10	Storeman	SPR	E2	
Battle Group Engineer Party (1:1)				
11*	Engineer Liaison Officer	CAPT	O3	
12*	Driver	SPR	E2	
Engineer Reconnaissance (1:14, although 1:20 is desirable)				
13*	Reconnaissance Office	CAPT	O3	
14*	Reconnaissance SNCO	SGT	E6	
15*	Reconnaissance SNCO	SGT	E6	
16*	Reconnaissance Section Commander	CPL	E5	
17*	Reconnaissance Section 2IC	LCPL	E4	
18*	Combat Engineer	SPR	E2	
19*	Combat Engineer	SPR	E2	
20*	Combat Engineer	SPR	E2	
21*	Combat Engineer	SPR	E2	
22*	Reconnaissance Section Commander	CPL	E5	
23*	Reconnaissance Section 2IC	LCPL	E4	
24*	Combat Engineer	SPR	E2	
25*	Combat Engineer	SPR	E2	
26*	Combat Engineer	SPR	E2	
27*	Combat Engineer	SPR	E2	
Highly desired by 24 Cdo Engr Regt, RE from results of 2010 wargames	Reconnaissance Section Commander	CPL	E5	
	Reconnaissance Section 2IC	LCPL	E4	
	Combat Engineer	SPR	E2	
	Combat Engineer	SPR	E2	
	Combat Engineer	SPR	E2	
	Combat Engineer	SPR	E2	

Field Engineer Troop 1 (1:30)				
28*	Troop Commander	LT	O2	
29*	Troop Reconnaissance SSGT	SSGT	E7	
30*	Troop Administration SGT	SGT	E7	
31*	Troop Signaller	SPR	E2	
32*	Combat Engineer Section Commander	CPL	E5	
33*	Combat Engineer Section 2IC	LCPL	E4	
34*	Combat Engineer	SPR	E2	
35*	Combat Engineer	SPR	E2	
36*	Combat Engineer	SPR	E2	
37*	Combat Engineer	SPR	E2	
38*	Combat Engineer	SPR	E2	
39*	Combat Engineer	SPR	E2	
40*	Combat Engineer	SPR	E2	
41*	Combat Engineer Section Commander	CPL	E5	
42*	Combat Engineer Section 2IC	LCPL	E4	
43*	Combat Engineer	SPR	E2	
44*	Combat Engineer	SPR	E2	
45*	Combat Engineer	SPR	E2	
46*	Combat Engineer	SPR	E2	
47*	Combat Engineer	SPR	E2	
48*	Combat Engineer	SPR	E2	
49*	Combat Engineer	SPR	E2	
50*	Combat Engineer Section Commander	CPL	E5	
51*	Combat Engineer Section 2IC	LCPL	E4	
52*	Combat Engineer	SPR	E2	
53*	Combat Engineer	SPR	E2	
54*	Combat Engineer	SPR	E2	
55*	Combat Engineer	SPR	E2	
56*	Combat Engineer	SPR	E2	
57*	Combat Engineer	SPR	E2	
58*	Combat Engineer	SPR	E2	
Field Engineer Troop 2 (1:30)				
59*	Troop Commander	LT	O2	
60*	Troop Reconnaissance SSGT	SSGT	E7	
61*	Troop Administration SGT	SGT	E7	
62*	Troop Signaller	SPR	E2	
63*	Combat Engineer Section Commander	CPL	E5	
64*	Combat Engineer Section 2IC	LCPL	E4	
65*	Combat Engineer	SPR	E2	
66*	Combat Engineer	SPR	E2	
67*	Combat Engineer	SPR	E2	
68*	Combat Engineer	SPR	E2	
69*	Combat Engineer	SPR	E2	
70*	Combat Engineer	SPR	E2	
71*	Combat Engineer	SPR	E2	
72*	Combat Engineer Section Commander	CPL	E5	

73*	Combat Engineer Section 2IC	LCPL	E4	
74*	Combat Engineer	SPR	E2	
75*	Combat Engineer	SPR	E2	
76*	Combat Engineer	SPR	E2	
77*	Combat Engineer	SPR	E2	
78*	Combat Engineer	SPR	E2	
79*	Combat Engineer	SPR	E2	
80*	Combat Engineer	SPR	E2	
81*	Combat Engineer Section Commander	CPL	E5	
82*	Combat Engineer Section 2IC	LCPL	E4	
83*	Combat Engineer	SPR	E2	
84*	Combat Engineer	SPR	E2	
85*	Combat Engineer	SPR	E2	
86*	Combat Engineer	SPR	E2	
87*	Combat Engineer	SPR	E2	
88*	Combat Engineer	SPR	E2	
89*	Combat Engineer	SPR	E2	
Field Engineer Troop 3 (1:30) – Highly Desirable by 24 Cdo Engr Regt, RE				
Highly desired by 24 Cdo Engr Regt, RE from results of 2010 wargames	Troop Commander	LT	O2	
	Troop Reconnaissance SSGT	SSGT	E7	
	Troop Administration SGT	SGT	E7	
	Troop Signaller	SPR	E2	
	Combat Engineer Section Commander	CPL	E5	
	Combat Engineer Section 2IC	LCPL	E4	
	Combat Engineer	SPR	E2	
	Combat Engineer	SPR	E2	
	Combat Engineer	SPR	E2	
	Combat Engineer	SPR	E2	
	Combat Engineer	SPR	E2	
	Combat Engineer	SPR	E2	
	Combat Engineer	SPR	E2	
	Combat Engineer Section Commander	CPL	E5	
	Combat Engineer Section 2IC	LCPL	E4	
	Combat Engineer	SPR	E2	
	Combat Engineer	SPR	E2	
	Combat Engineer	SPR	E2	
	Combat Engineer	SPR	E2	
	Combat Engineer	SPR	E2	
	Combat Engineer Section Commander	CPL	E5	
	Combat Engineer Section 2IC	LCPL	E4	
	Combat Engineer	SPR	E2	
	Combat Engineer	SPR	E2	
	Combat Engineer	SPR	E2	
	Combat Engineer	SPR	E2	
	Combat Engineer	SPR	E2	
	Combat Engineer	SPR	E2	
	Combat Engineer	SPR	E2	

Support Engineering Troop (1:35) – Generic, but usually tailored for a mission *Note:* May deploy as Squadron with SHQ of 1 x MAJ, 1 x CAPT, and 1 x WO2				
90*	Troop Officer	LT	O2	
Construction Supervision Cell (0:6)				
91*	Civil Supervisor	SGT	E7	
92*	Clerk of Works	WO1	E9	
93*	Electrical Supervisor	SSGT	E8	
94*	Mechanical Supervisor	SSGT	E8	
95*	Construction Supervisor	SSGT	E8	
96*	Plant Foreman	SSGT	E8	
97*	Draughtsman	LCPL	E4	
Resources (Trade) Element (0:15)				
98*	Resources Section Commander	CPL	E5	
99*	Resources Section 2IC	LCPL	E4	
100*	Resources Section	SPR	E3	
101*	Resources Section	SPR	E3	
102*	Resources Section	SPR	E3	
103*	Resources Section Commander	CPL	E5	
104*	Resources Section 2IC	LCPL	E4	
105*	Resources Section	SPR	E3	
106*	Resources Section	SPR	E3	
107*	Resources Section	SPR	E3	
108*	Resources Section Commander	CPL	E5	
109*	Resources Section 2IC	LCPL	E4	
110*	Resources Section	SPR	E3	
111*	Resources Section	SPR	E3	
112*	Resources Section	SPR	E3	
Plant Section (0:6)				
113*	Plant Section Commander	CPL	E5	
114*	Plant Operator 2IC	LCPL	E4	
115*	Plant Operator	SPR	E3	
116*	Plant Operator	SPR	E3	
117*	Plant Operator	SPR	E3	
118*	Plant Operator	SPR	E3	
Motor Transport Section (0:8)				
119*	Motor Transport Section Commander	CPL	E5	
120*	Truck Driver 2IC	LCPL	E4	
121*	Truck Driver	SPR	E2	
122*	Truck Driver	SPR	E2	
123*	Truck Driver	SPR	E2	
124*	Truck Driver	SPR	E2	
125*	Truck Driver	SPR	E2	
126*	Truck Driver	SPR	E2	

Table 13. Royal Engineer Support to a Royal Marine Commando Battle Group

1st Combat Engineer Regiment (Squadron/Company Group), Operation PADANG ASSIST, November 2009, Humanitarian Assistance/Disaster Relief Operation

Total manning: 12 Officers and 138 Enlisted (Total personnel – 150)
Manning for specialisations provided by Royal Australian Engineers: 5 Officers and 82 Enlisted

Position No.	Billet Description	Rank	Grade	Remarks
Squadron Group Command Element (4:6, Officers : Enlisted)				
1*	Commander	MAJ	O4	
2*	Second-in-Command (2IC)	CAPT	O3	
3*	Reconnaissance Office / Liaison Officer	CAPT	O3	
4*	Squadron Sergeant Major (Engineer Chief)	WO2	E8	
5	Orderly Room Clerk	CPL	E5	
6	Signaller	CPL	E5	
7*	Signaller	SPR	E2	
8	Padre	Chaplain		
9	Interpreter 1			
10	Interpreter 2			
Field / Combat Engineer Troop 1 (Platoon) (1:27)				
11*	Troop Commander	LT	O2	
12*	Troop Reconnaissance SGT	SGT	E7	
13*	Troop Administration SGT	SGT	E7	DSO
14	Troop Storeman	SPR	E2	
15*	Combat Engineer Section 1 Commander	CPL	E5	
16*	Combat Engineer Section 1 2IC	LCPL	E4	Diver
17*	Combat Engineer Section 1	SPR	E2	Diver
18*	Combat Engineer Section 1	SPR	E2	Diver
19*	Combat Engineer Section 1	SPR	E2	Diver
20*	Combat Engineer Section 1	SPR	E2	
21*	Combat Engineer Section 1	SPR	E2	
22*	Combat Engineer Section 1	SPR	E2	
23*	Combat Engineer Section 2 Commander	CPL	E5	ROWPU
24*	Combat Engineer Section 2 2IC	LCPL	E4	ROWPU
25*	Combat Engineer Section 2	SPR	E2	ROWPU
26*	Combat Engineer Section 2	SPR	E2	ROWPU
27*	Combat Engineer Section 2	SPR	E2	ROWPU
28*	Combat Engineer Section 2	SPR	E2	ROWPU
29*	Combat Engineer Section 2	SPR	E2	ROWPU
30*	Combat Engineer Section 2	SPR	E2	ROWPU
31*	Combat Engineer Section 3 Commander	CPL	E5	ROWPU
32*	Combat Engineer Section 3 2IC	LCPL	E4	ROWPU
33*	Combat Engineer Section 3	SPR	E2	ROWPU
34*	Combat Engineer Section 3	SPR	E2	ROWPU
35*	Combat Engineer Section 3	SPR	E2	ROWPU
36*	Combat Engineer Section 3	SPR	E2	ROWPU
37*	Combat Engineer Section 3	SPR	E2	ROWPU
38*	Combat Engineer Section 3	SPR	E2	ROWPU

Field / Combat Engineer Troop 2 (Platoon) (1:27)				
39*	Troop Commander	LT	O2	
40*	Troop Reconnaissance SGT	SGT	E7	
41*	Troop Administration SGT	SGT	E7	
42	Troop Storeman	SPR	E2	
43*	Combat Engineer Section 1 Commander	CPL	E5	
44*	Combat Engineer Section 1 2IC	LCPL	E4	
45*	Combat Engineer Section 1	SPR	E2	
46*	Combat Engineer Section 1	SPR	E2	
47*	Combat Engineer Section 1	SPR	E2	
48*	Combat Engineer Section 1	SPR	E2	
49*	Combat Engineer Section 1	SPR	E2	
50*	Combat Engineer Section 1	SPR	E2	
51*	Combat Engineer Section 2 Commander	CPL	E5	
52*	Combat Engineer Section 2 2IC	LCPL	E4	
53*	Combat Engineer Section 2	SPR	E2	
54*	Combat Engineer Section 2	SPR	E2	
55*	Combat Engineer Section 2	SPR	E2	
56*	Combat Engineer Section 2	SPR	E2	
57*	Combat Engineer Section 2	SPR	E2	
58*	Combat Engineer Section 2	SPR	E2	
59*	Combat Engineer Section 3 Commander	CPL	E5	
60*	Combat Engineer Section 3 2IC	LCPL	E4	
61*	Combat Engineer Section 3	SPR	E2	
62*	Combat Engineer Section 3	SPR	E2	
63*	Combat Engineer Section 3	SPR	E2	
64*	Combat Engineer Section 3	SPR	E2	
65*	Combat Engineer Section 3	SPR	E2	
66*	Combat Engineer Section 3	SPR	E2	
Plant Troop (Equipment Platoon) (1:17)				
67*	Troop Commander	LT	O2	
68*	Civil Supervisor	SGT	E7	
69*	Plant Section A Commander	CPL	E5	
70*	Plant Section A	SPR	E3	
71*	Plant Section A	SPR	E3	
72*	Plant Section A	SPR	E3	
73*	Plant Section B Commander	CPL	E5	
74*	Plant Section B	SPR	E3	
75*	Plant Section B	SPR	E3	
76*	Plant Section B	SPR	E3	
77*	Plant Section C Commander	CPL	E5	
78*	Plant Section C	SPR	E3	
79*	Plant Section C	SPR	E3	
80*	Plant Section C	SPR	E3	
81*	Mack Driver (8t Dump Truck)	CPL	E5	
82*	Mack Driver (8t Dump Truck)	SPR	E2	
83*	Unimog Driver (4t Dump Truck)	SPR	E2	
84*	Unimog Driver (4t Cargo Truck)	SPR	E2	

Specialist Troop (Utilities Platoon) (1:13)				
85*	Troop Commander	LT	O2	
86*	Building/Construction/Services Supervisor	SGT	E7	
87*	Carpenter	CPL	E5	
88*	Carpenter	SPR	E3	
89*	Electrician	LCPL	E4	
90*	Electrician	SPR	E3	
91*	Electrician	SPR	E3	
92*	Plumber	LCPL	E4	
93*	Plumber	SPR	E3	
94*	Emergency Responder Det Commander	CPL	E5	HAZMAT
95*	Emergency Responder	LCPL	E4	HAZMAT
96*	Emergency Responder	SPR	E3	HAZMAT
97*	Emergency Responder	SPR	E3	HAZMAT
Combat Service Support Team (5:48)				
98	Commander	MAJ	O4	
99	Operations Officer	CAPT	O3	
100	Watchkeeper 1 / Troop Commander	LT	O2	
101	Watchkeeper 2	WO2	E8	
102	Company Sergeant Major	WO2	E8	
103	Orderly Room Clerk	CPL	E5	
104	Signaller	LCPL	E4	
105	Petroleum Operator Det Commander	CPL	E5	
106	Petroleum Operator	PTE	E3	Driver
107	Petroleum Operator	PTE	E3	
108	Primary Health Care Team Adv Med Assist 1	SGT	E7	
109	Primary Health Care Team Adv Med Assist 2	CPL	E5	
110	Primary Health Care Team Ambulance Driver	PTE	E3	
111	Transport Supervisor	CPL	E5	
112	Mack Driver (8t Cargo Truck)	LCPL	E4	
113*	Mack Driver (8t Cargo Truck)	PTE	E2	
114	Unimog Driver (4t Cargo Truck)	PTE	E2	
115	Unimog Driver (4t Cargo Truck)	PTE	E2	
116	Forward Repair Team – Sergeant Major	WO2	E8	
117	Forward Repair Team – SGT	SGT	E7	
118	Forward Repair Team – Repair Parts Store	CPL	E5	
119	Forward Repair Team – Technician Electrical	CPL	E5	
120	Forward Repair Team – Technician Electrical	CFN	E3	
121	Forward Repair Team – Recovery Mechanic	LCPL	E4	
122	Forward Repair Team – Recovery Mechanic	CFN	E3	
123	Forward Repair Team – Vehicle Mechanic	CPL	E5	
124	Forward Repair Team – Vehicle Mechanic	LCPL	E4	
125	Forward Repair Team – Vehicle Mechanic	CFN	E3	
126	Forward Repair Team – Vehicle Mechanic	CFN	E3	
127	Forward Repair Team – Vehicle Mechanic	CFN	E3	
128	Forward Repair Team – Vehicle Mechanic	CFN	E3	
129	Forward Repair Team – Welder	CPL	E5	
130	Forward Repair Team – Welder	CFN	E3	
131	Forward Repair Team – Armourer	LCPL	E4	

132	Supply – Quartermaster	CAPT	O3	
133	Supply – Warrant Officer Control	WO2	E8	
134	Supply – Common Visibility System Operator	CPL	E5	
135	Supply – Class VIII	SGT	E7	
136	Supply – Engineer Storeman	CPL	E5	
137	Supply – Engineer Storeman	PTE	E2	
138	Supply – Engineer Storeman	PTE	E2	
139*	Supply – Engineer Storeman	SPR	E3	Carpenter
140	Supply – Local Purchase	CPL	E5	
141	Supply – Foodstuffs	CPL	E5	
142	Supply – RIS	CPL	E5	
143	Supply – Contract Manager	WO2	E8	
144	Terminal Operator Det Commander	CPL	E5	
145	Terminal Operator	LCPL	E4	
146	Terminal Operator	PTE	E2	
147	Terminal Operator	PTE	E2	
148	Terminal Operator	PTE	E2	
149	Terminal Operator	PTE	E2	
150	Pay Clerk / Cashier	WO2	E8	

Table 14. Engineer Task Force for Operation PADANG ASSIST, 2009

APPENDIX F

Likely Tasks for Amphibious Engineers by Amphibious Operation Type

Scenario 1 – Support to an Amphibious Ready Element (ARE) conducting Phase Zero (Shaping) operations, minor HA/DR operations, and NEO

The ARE provides the short-notice amphibious capability and amphibious operations are its primary role. The ARE is to be prepared to conduct a HA/DR or NEO mission within 48 hours. The **minimum capability**, in terms of amphibious platform, would be **one LHD**. The ARE should be capable of conducting coordinated air and surface over-the-horizon (OTH) assaults of up to three platoons-sized Force Elements, plus an Offensive Support Detachment, and Combat Team Tactical Headquarters. The **minimum Landing Force** for this mission would be a **Combat Team based on an infantry company** with protected mobility, indirect offensive support, mobility and survivability attachments, and ISTAR assets.

Task – by functional area	Combat Engineer	Support Engineer	Specialist	ESR
General				
Conduct defensive operations	X	X		
Geospatial				
Produce paper and digital terrain maps			X	
Mobility				
Conduct EO clearance (UXO, IED & booby traps)	X			
Engineer search tasks (caches, areas & buildings)	X			
Engineer search tasks (personnel & vehicles)	X			
Reduce obstacles below the high tide mark	X		X	
Construct/improve beach exits		X		
Conduct route reconnaissance (incl bridges)	X	X		
Construct/improve pioneer tracks	X	X		
Expediently maintain tracks		X		
Construct corduroy roads	X	X		
Construct expedient bridges	X	X		
Construct Helicopter Landing Zones	X	X		
Counter-Mobility				
Plan/install obstacles and barriers	X			
Survivability				
Construct strong points	X	X		
Construct vehicle check points (VCPs)	X	X		
Conduct CBRN decontamination	X		X	
HAZMAT removal and decontamination			X	
Air Crash Rescue			X	
General Engineering / Sustainability				
Construct hardstands and dump areas		X		
Establish maintenance areas		X		
Clearing of bivouac/camp areas		X		
Construct semi-permanent camps	X	X		
Construct showers and ablutions		X		

Construct Field Hospital		X		
Construct Internally Displaced Persons (IDP) camp	X	X		
Structural assessment of damaged buildings		X	X	X
Demolition of damaged buildings	X	X		
Render safe buildings (structural and electrical)		X		
Install power distribution system		X		
Construct/improve road (incl culverts)		X		
Maintain roads		X		
Construct/repair drainage		X		
Remove rubbish/debris from routes		X		
Repair airfield damage		X		
Water point reconnaissance	X			
Water supply	X			
Recovery and temporary burial of dead bodies	X	X		
Construct/repair SPOD	X	X		X

Table 15. Likely Engineer Tasks for an ARE Conducting Phase Zero, NEO, and HA/DR Operations

Scenario 2 – Engineer Task Force conducting a major HA/DR operation

Planning assumptions include: 1 or 3 Brigade (located in the north of Australian in Darwin and Townsville respectively) would provide the response to **large scale natural disasters** in countries to the West of West Papua/Irian Jaya or PNG and the Pacific, respectively; Recon Team (REC) is to be prepared to deploy within 24 hours of a natural disaster occurring; CER CSS element is to provide 1st and 2nd line support to CER elements and all other deployed forces; 1 or 3 Brigade units and some external-to-Brigade units will supplement CER; a Field Hospital would not be deployed in the vicinity of the CER element; a manning cap of 150 would be set by HQJOC; a minimum of 48 hours would be required to prepare all personnel and equipment with zero notice; and local transport, contractors and mobile telephone network cannot be relied upon.

A 'large scale' natural disaster **is defined** by the author as a natural disaster which has killed more than 1,000 people; or a high threat of environmental hazards exists arising from a natural disaster that could produce casualties in the order of thousands of people; or major water supply problems have been identified after a natural disaster. Examples are the Indian Ocean Boxing Day Tsunami in 2004 and the Padang earthquake on September 30, 2009.

Task – by functional area	**Combat Engineer**	**Support Engineer**	**Specialist**	**ESR**
Geospatial				
Produce paper and digital terrain maps			X	
Mobility				
Reduce obstacles below the high tide mark	X		X	
Construct/improve beach exits		X		
Conduct route reconnaissance (incl bridges)	X	X		
Construct/improve pioneer tracks	X	X		
Expediently maintain tracks		X		
Construct corduroy roads	X	X		
Construct expedient bridges	X	X		
Construct Helicopter Landing Zones	X	X		
Counter-Mobility				
No planned tasks				
Survivability				
HAZMAT removal and decontamination			X	
Air Crash Rescue			X	
General Engineering / Sustainability				
Construct hardstands and dump areas		X		
Establish maintenance areas		X		
Clearing of bivouac/camp areas		X		
Construct semi-permanent camps	X	X		
Construct showers and ablutions		X		
Construct Field Hospital		X		
Construct Internally Displaced Persons (IDP) camp	X	X		
Structural assessment of damaged buildings		X	X	X
Demolition of damaged buildings	X	X		
Render safe buildings (structural and electrical)		X		

Install power distribution system		X		
Construct/improve road (incl culverts)		X		
Maintain roads		X		
Construct/repair drainage		X		
Remove rubbish/debris from routes		X		
Repair airfield damage		X		
Water point reconnaissance	X			
Water supply	X			
Recovery and temporary burial of dead bodies	X	X		
Construct/repair SPOD	X	X		X

Table 16. Likely Engineer Tasks for an Engineer Task Force Conducting a Major HA/DR Operation

Scenario 3 – Support to an Amphibious Ready Group (ARG) conducting regional stability operations

The ARG is **based on two RAN LHDs and a RAN LSD** (TBC). The ARG should be capable of conducting coordinated air and surface STOM assaults of up to four Infantry/Cavalry/ Tank Combat Teams, plus an Offensive Support Battery, and a Battle Group Tactical Headquarters. The LF is a medium-weight Battle Group of up to 2,200 personnel with associated stores and equipment, supported by engineers, armed reconnaissance helicopters, and heavy/medium lift helicopters.

This scenario would involve the ARG providing the majority of force elements for a **regional coalition stability mission**, such as the Regional Assistance Mission to the Solomon Islands in 2003 and East Timor in 2006.

Task – by functional area	**Combat Engineer**	**Support Engineer**	**Specialist**	**ESR**
General				
Fight as infantry	X			
Conduct defensive operations	X	X		
Geospatial				
Produce paper and digital terrain maps			X	
Mobility				
Reduce obstacles below the high tide mark	X		X	
Construct/improve beach exits		X		
Conduct route reconnaissance (incl bridges)	X	X		
Construct/improve pioneer tracks	X	X		
Construct corduroy roads	X	X		
Construct expedient bridges	X	X		
Conduct EO clearance (UXO, IED & booby traps)	X			
Conduct route clearance (mines, IED & booby traps)	X			
Engineer search tasks (caches, areas & buildings)	X			
Engineer search tasks (personnel & vehicles)	X			
Reduce enemy obstacles and barriers	X	X		
Reduce enemy fortifications and bunkers	X	X		
Construct Helicopter Landing Zones	X	X		
Counter-Mobility				
Plan/install obstacles and barriers	X	X		
Survivability				
Construct fighting positions		X		
Construct strong points	X	X		
Construct vehicle check points (VCPs)	X	X		
Construct Command Posts (CPs)/First Aid Stations	X	X		
Harden buildings and facilities	X			
Construct FOB perimeter walls	X	X		
HAZMAT removal and decontamination (incl WWII chemical munitions)	X		X	
Air Crash Rescue			X	

General Engineering / Sustainability				
Construct hardstands and dump areas		X		
Establish maintenance areas		X		
Clearing of bivouac/camp areas		X		
Construct semi-permanent camps	X	X		
Construct showers and ablutions		X		
Construct Field Hospital		X		
Construct detainee compound	X	X		
Install power distribution system		X		
Construct/improve road (incl culverts)		X		
Maintain roads		X		
Remove rubbish/debris from routes		X		
Repair airfield damage		X		
Build expedient airfields	X	X		
Improve airfields (extend & construct aprons)		X		
Construct FARP		X		
Construct fuel pumping system (incl pipeline)		X		
Water point reconnaissance	X			
Water supply	X	X		
Unloading of amphibious watercraft		X		
Construct/repair SPOD	X	X		

Table 17. Likely Engineer Tasks for an ARG Conducting Regional Stability Operations

Scenario 4 – Support to an Amphibious Ready Group (ARG) conducting entry operations for a medium intensity regional conflict

The ARG is **based on two RAN LHDs and a RAN LSD** (TBC). The ARG should be capable of conducting coordinated air and surface STOM assaults of up to four Infantry/Cavalry/ Tank Combat Teams, plus an Offensive Support Battery, and a Battle Group Tactical Headquarters. The LF is a medium-weight Battle Group of up to 2,200 personnel with associated stores and equipment, supported by engineers, armed reconnaissance helicopters, and heavy/medium lift helicopters.

This scenario would involve the **ARG securing a SPOD and APOD for follow on forces provided by Australia and its regional partners**, such as for the International Force East Timor (INTERFET) in 1999. Engineers from the 6th Engineer Support Regiment (6 ESR), deploying in Black bottom ships, would be required to rapidly follow the ARG engineers in order to provide Force Level Engineering that is outside the capabilities of the ARG engineers. The 6 ESR follow-on forces would not need to be supplemented by additional coalition engineers.

Task – by functional area	Combat Engineer	Support Engineer	Specialist	ESR
General				
Fight as infantry	X			
Conduct defensive operations	X	X		X
Geospatial				
Produce paper and digital terrain maps			X	X
Conduct land survey tasks				X
Mobility				
Reduce obstacles below the high tide mark	X		X	
Construct/improve beach exits		X		
Conduct route reconnaissance (incl bridges)	X	X		
Construct/improve pioneer tracks	X	X		
Expediently maintain tracks		X		
Construct corduroy roads	X	X		
Construct expedient bridges	X	X		
Minefield reconnaissance	X			
Clear mines	X			
Conduct EO clearance (UXO, IED & booby traps)	X			
Conduct route clearance (mines, IED & booby traps)	X			
Engineer search tasks (caches, areas & buildings)	X			
Engineer search tasks (personnel & vehicles)	X			
Destroy enemy weapons and equipment	X			
Reduce enemy obstacles and barriers	X	X		
Reduce enemy fortifications and bunkers	X	X		
Construct Helicopter Landing Zones	X	X		X
Counter-Mobility				
Plan/install obstacles and barriers	X	X		
Survivability				
Construct fighting positions		X		
Construct strong points	X	X		

Construct vehicle check points (VCPs)	X	X		
Construct Command Posts (CPs)/First Aid Stations	X	X		
Harden buildings and facilities	X			
Construct FOB perimeter walls	X	X		X
HAZMAT removal and decontamination (incl WWII chemical munitions)	X		X	
Air Crash Rescue			X	
General Engineering / Sustainability				
Construct hardstands and dump areas		X		
Establish maintenance areas		X		
Clearing of bivouac/camp areas		X		
Construct semi-permanent camps		X		X
Construct showers and ablutions		X		X
Construct sewage treatment plants/ponds				X
Construct Field Hospital				X
Construct detainee compound	X	X		
Install power distribution system		X		X
Construct/improve road (incl culverts)		X		X
Maintain roads				X
Remove rubbish/debris from routes		X		
Repair airfield damage		X		X
Build expedient airfields	X	X		X
Improve airfields (extend & construct aprons)				X
Construct FARP		X		
Construct fuel pumping system (incl pipeline)		X		X
Water point reconnaissance	X			X
Water supply	X	X		X
Unloading of amphibious watercraft		X		
Construct/repair SPOD	X	X		X
Support CMO/CIMIC tasks		X		X

Table 18. Likely Engineer Tasks for an ARG Conducting Entry Operations for a Medium Intensity Regional Conflict

Scenario 5 – Support to an Amphibious Ready Group (ARG) conducting entry operations for a major regional conflict involving a Coalition Task Force

The ARG is **based on two RAN LHDs and a RAN LSD** (TBC). The ARG should be capable of conducting coordinated air and surface STOM assaults of up to four Infantry/Cavalry/ Tank Combat Teams, plus an Offensive Support Battery, and a Battle Group Tactical Headquarters. The LF is a medium-weight Battle Group of up to 2,200 personnel with associated stores and equipment, supported by engineers, armed reconnaissance helicopters, and heavy/medium lift helicopters.

This regional scenario would involve the **ARG securing one of several SPODs and APODs for follow on forces provided by the US and major international partners**, in the manner of 3 CDO BDE RM in the Falkland Islands in 1982 and 15th/26th MEUs in seizing APODs in Afghanistan in 2001. Coalition engineers, such as NCF Seabees and 6 ESR, would be required to rapidly follow the ARG engineers in order to provide Force Level Engineering that is outside the capabilities of the ARG engineers.

Task – by functional area	Combat Engineer	Support Engineer	Specialist	NCF/ ESR
General				
Fight as infantry	X			
Conduct defensive operations	X	X		X
Geospatial				
Produce paper and digital terrain maps			X	X
Conduct land survey tasks				X
Mobility				
Reduce obstacles below the high tide mark	X		X	
Construct/improve beach exits		X		
Conduct route reconnaissance (incl bridges)	X	X		
Construct/improve pioneer tracks	X	X		
Expediently maintain tracks		X		
Construct corduroy roads	X	X		
Construct expedient bridges (combat, tactical and LOC)	X	X		
Minefield reconnaissance	X			
Clear mines	X			
Breach minefields and obstacles	X			
Conduct EO clearance (UXO, IED & booby traps)	X			
Conduct route clearance (mines, IED & booby traps)	X			
Engineer search tasks (caches, areas & buildings)	X			
Engineer search tasks (personnel & vehicles)	X			
Destroy enemy weapons and equipment	X			
Reduce enemy obstacles and barriers	X	X		
Reduce enemy fortifications and bunkers	X	X		
Support urban operational mobility	X			
Construct Helicopter Landing Zones	X	X		X
Airfield assessment – capacity		X		X

Counter-Mobility				
Plan/install obstacles and barriers	X	X		
Plan/install tactical obstacles	X	X		X
Plan/install minefields	X			
Survivability				
Construct fighting positions		X		
Construct strong points	X	X		
Construct vehicle check points (VCPs)	X	X		
Construct Command Posts (CPs)/First Aid Stations	X	X		
Harden buildings and facilities	X			
Construct protective berms		X		
Construct FOB perimeter walls	X	X		X
HAZMAT removal and decontamination (incl WWII chemical munitions)	X		X	
Detect, mark and report CBRN hazards	X		X	
Decontaminate personnel and equipment	X		X	
CBRNE operations (site exploitation)	X	X	X	X
Air Crash Rescue			X	
Construct and employ decoys		X		X
General Engineering / Sustainability				
Construct hardstands and dump areas		X		
Establish maintenance areas		X		
Clearing of bivouac/camp areas		X		
Construct semi-permanent camps		X		X
Construct showers and ablutions		X		X
Construct sewage treatment plants/ponds				X
Construct Field Hospital				X
Construct detainee compound	X	X		
Install power distribution system		X		X
Waste management		X		
Construct/improve road (incl culverts)		X		X
Maintain roads				X
Remove rubbish/debris from routes		X		
Airfield reconnaissance/assessment		X		
Repair airfield damage		X		X
Build expedient airfields	X	X		X
Improve airfields (extend & construct aprons)				X
Maintain airfields (24h operations)		X		X
Construct VSTOL pad		X		
Construct FARP		X		
Construct fuel pumping system (incl pipeline)		X		X
Water point reconnaissance	X			X
Water supply	X	X		X
Unloading of amphibious watercraft		X		
Construct/repair SPOD	X	X		X
Support CMO/CIMIC tasks		X		X

Table 19. Likely Engineer Tasks for an ARG Conducting Entry Operations for a Major Regional Conflict Involving a Coalition Task Force

APPENDIX G

Proposed Engineer Support by Amphibious Operation Type

Scenario 1 – Support to an Amphibious Ready Element (ARE) conducting Phase Zero (Stability) operations, minor HA/DR operations, and NEO

The ARE provides the short-notice amphibious capability and amphibious operations are its primary role. The ARE is to be prepared to conduct a HA/DR or NEO mission within 48 hours. The **minimum capability**, in terms of amphibious platform, would be **one LHD**. The ARE should be capable of conducting coordinated air and surface over-the-horizon (OTH) assaults of up to three platoons-sized Force Elements, plus an Offensive Support Detachment, and Combat Team Tactical Headquarters. The **minimum Landing Force** for this mission would be a **Combat Team based on an infantry company** with protected mobility, indirect offensive support, mobility and survivability attachments, and ISTAR assets.

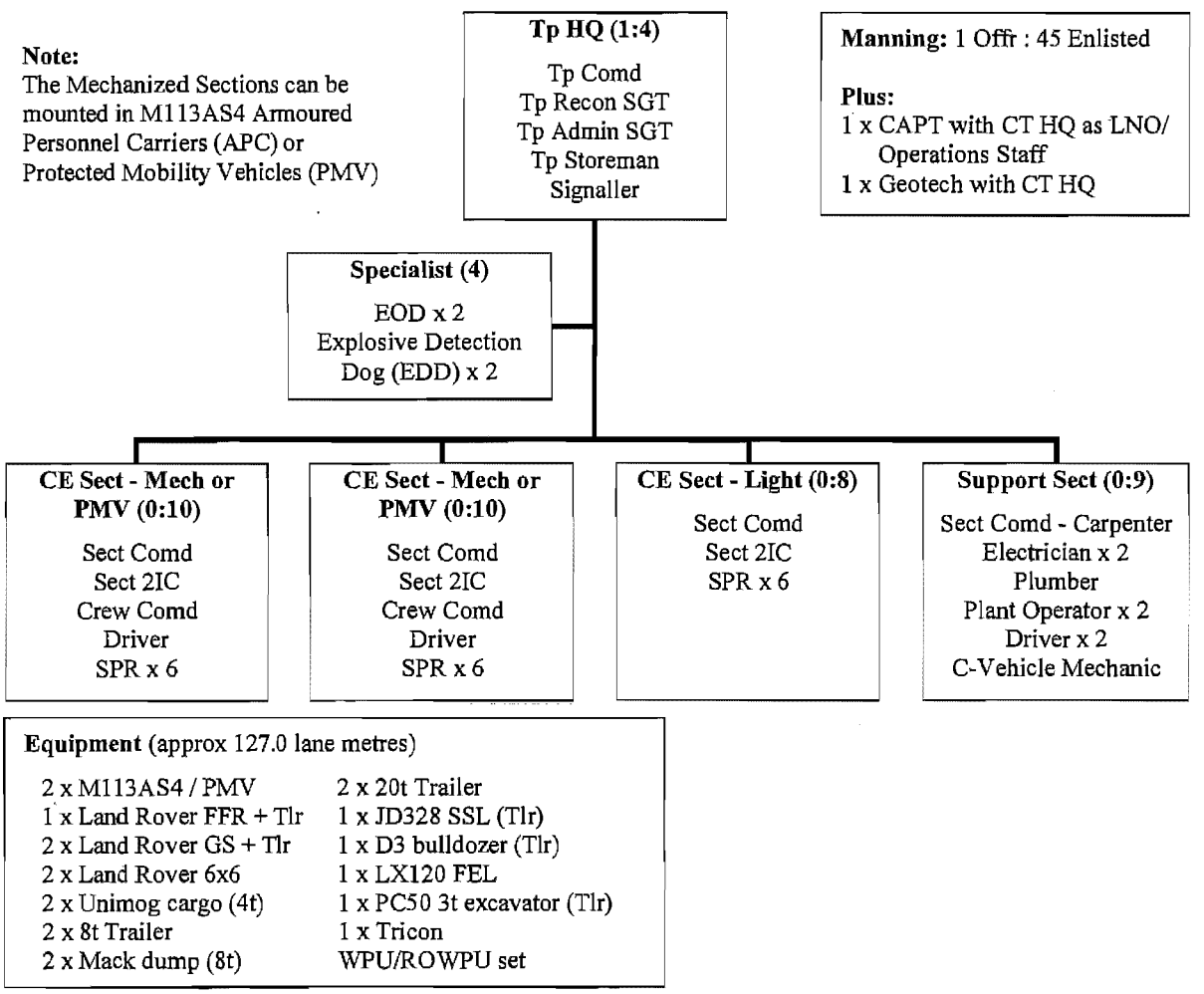

Figure 11. Proposed Engineer Support to an ARE Conducting Phase Zero, NEO, and HA/DR Operations

Scenario 2 – Engineer Task Force conducting a major HA/DR operation

Planning assumptions include: 1 or 3 Brigade (located in the north of Australian in Darwin and Townsville respectively) would provide the response to **large scale natural disasters** in countries to the West of West Papua/Irian Jaya or PNG and the Pacific, respectively; Recon Team (REC) is to be prepared to deploy within 24 hours of a natural disaster occurring; CER CSS element is to provide 1st and 2nd line support to CER elements and all other deployed forces; 1 or 3 Brigade units and some external-to-Brigade units will supplement CER; a Field Hospital would not be deployed in the vicinity of the CER element; a manning cap of 150 would be set by HQJOC; a minimum of 48 hours would be required to prepare all personnel and equipment with zero notice; and local transport, contractors and mobile telephone network cannot be relied upon.

A 'large scale' natural disaster **is defined** by the author as a natural disaster which has killed more than 1,000 people; or a high threat of environmental hazards exists arising from a natural disaster that could produce casualties in the order of thousands of people; or major water supply problems have been identified after a natural disaster. Examples are the Indian Ocean Boxing Day Tsunami in 2004 and the Padang earthquake on September 30, 2009.

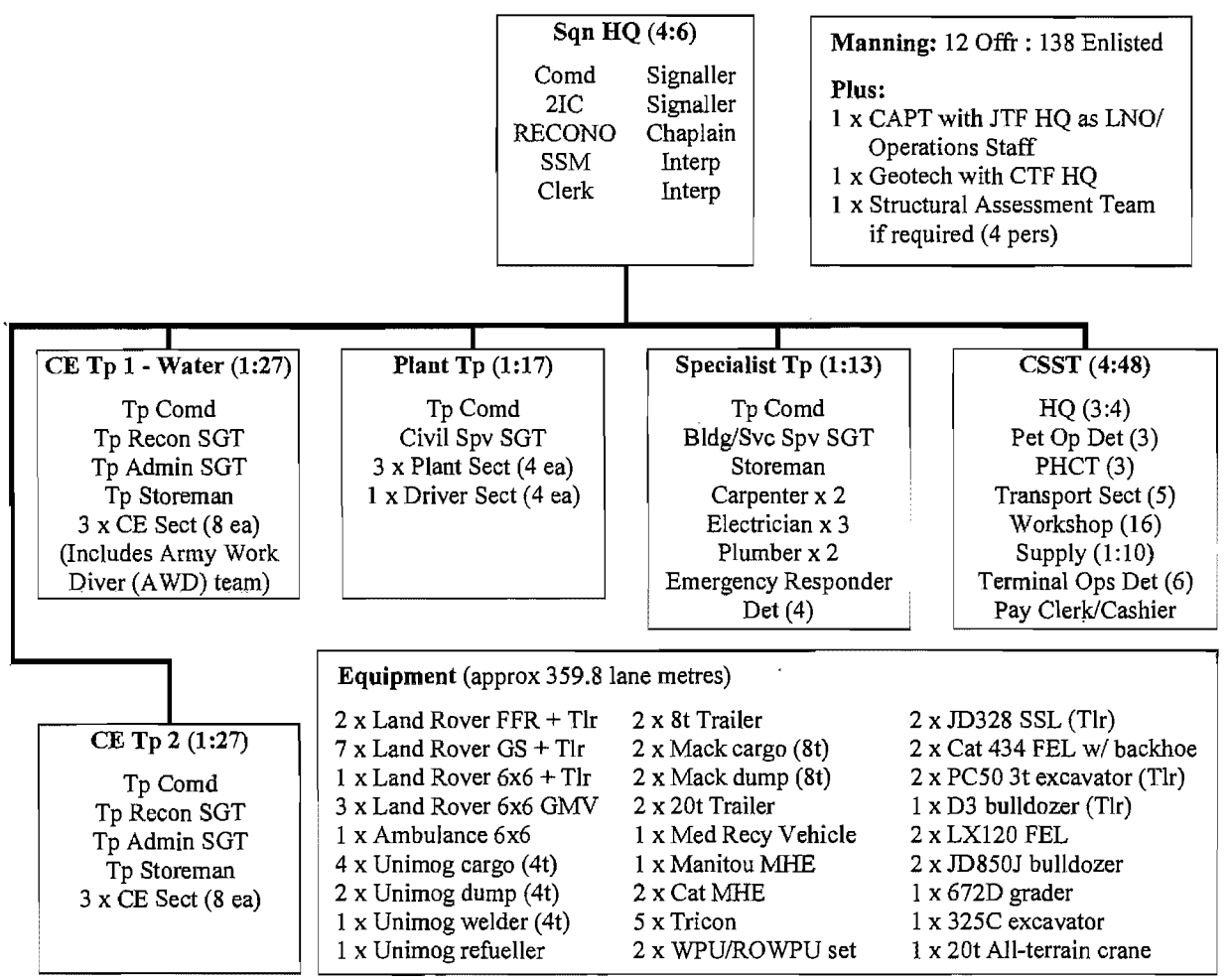

Figure 12. Proposed Engineer Task Force for Conducting Major HA/DR Operations

Scenario 3 – Support to an Amphibious Ready Group (ARG) conducting regional stability operations

The ARG is **based on two RAN LHDs and a RAN LSD** (TBC). The ARG should be capable of conducting coordinated air and surface STOM assaults of up to four Infantry/Cavalry/ Tank Combat Teams, plus an Offensive Support Battery, and a Battle Group Tactical Headquarters. The LF is a medium-weight Battle Group of up to 2,200 personnel with associated stores and equipment, supported by engineers, armed reconnaissance helicopters, and heavy/medium lift helicopters.

This scenario would involve the ARG providing the majority of force elements for a **regional coalition stability mission**, such as the Regional Assistance Mission to the Solomon Islands in 2003 and East Timor in 2006.

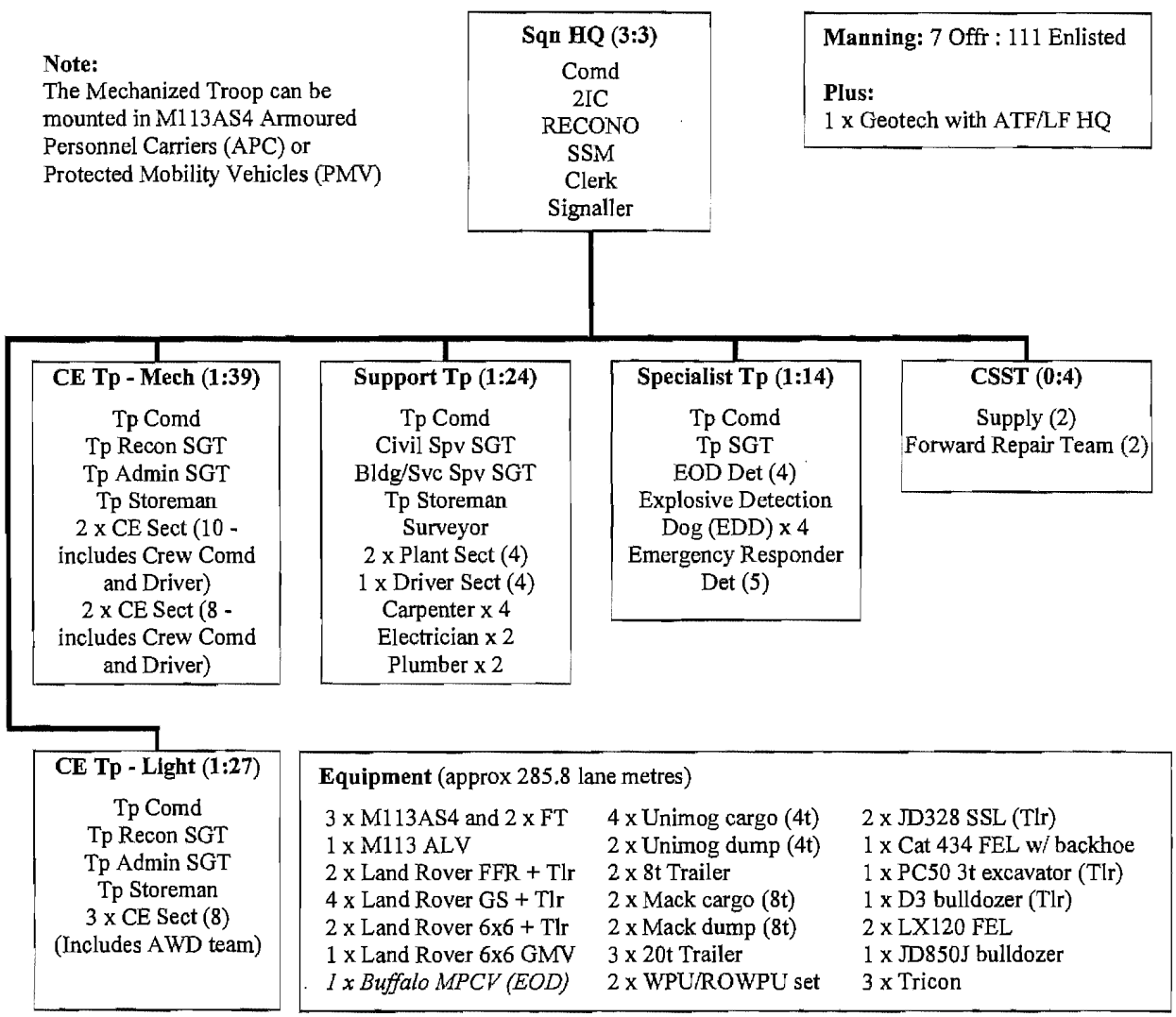

Figure 13. Proposed Engineer Support to an ARG Conducting Regional Stability Operations

Scenario 4 – Support to an Amphibious Ready Group (ARG) conducting entry operations for a medium intensity regional conflict

The ARG is **based on two RAN LHDs and a RAN LSD** (TBC). The ARG should be capable of conducting coordinated air and surface STOM assaults of up to four Infantry/Cavalry/ Tank Combat Teams, plus an Offensive Support Battery, and a Battle Group Tactical Headquarters. The LF is a medium-weight Battle Group of up to 2,200 personnel with associated stores and equipment, supported by engineers, armed reconnaissance helicopters, and heavy/medium lift helicopters.

This scenario would involve the **ARG securing a SPOD and APOD for follow on forces provided by Australia and its regional partners**, such as for the International Force East Timor (INTERFET) in 1999. Engineers from the 6th Engineer Support Regiment (6 ESR), deploying in Black bottom ships, would be required to rapidly follow the ARG engineers in order to provide Force Level Engineering that is outside the capabilities of the ARG engineers. The 6 ESR follow-on forces would not need to be supplemented by additional coalition engineers.

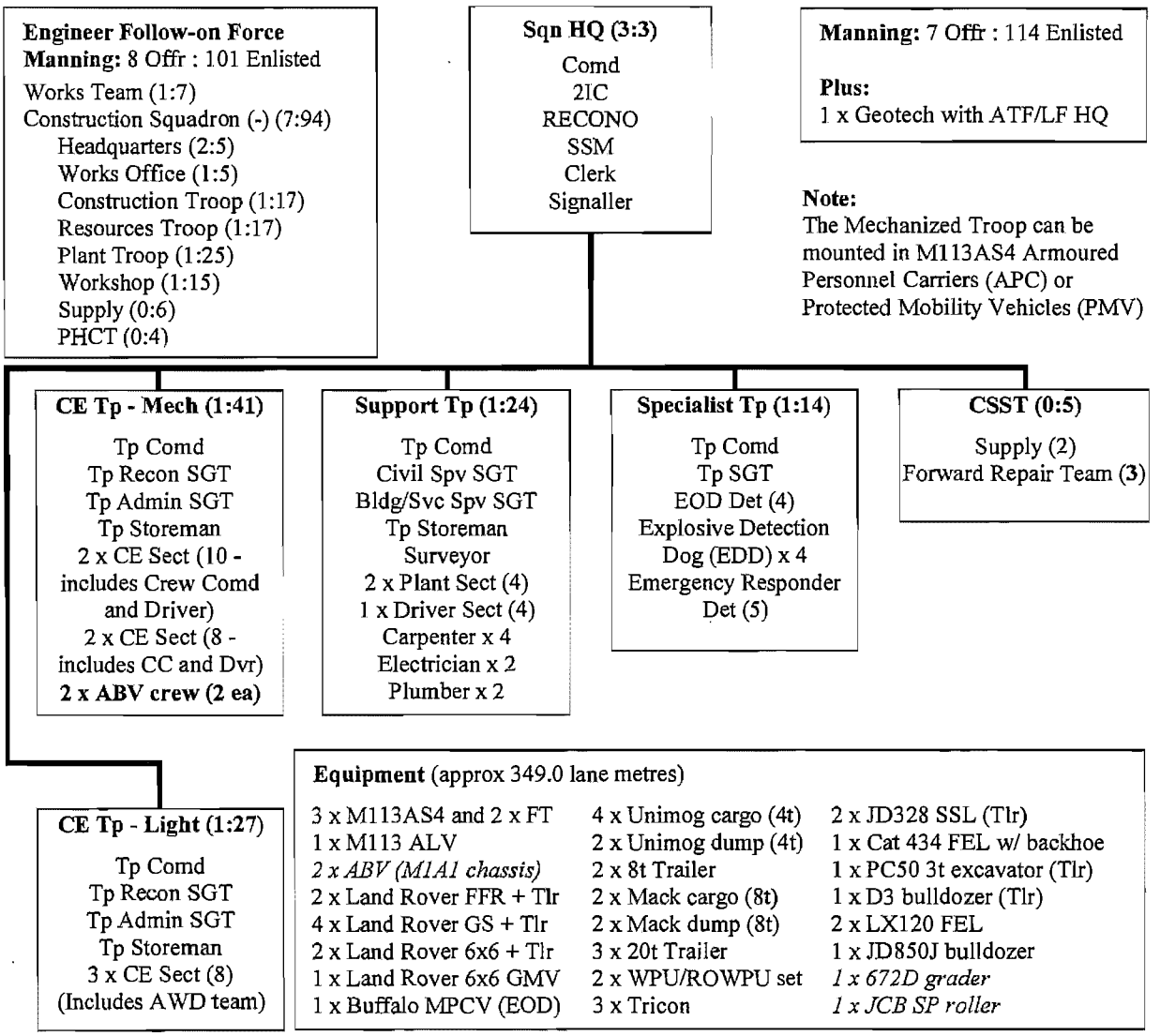

Figure 14. Proposed Engineer Support to an ARG Conducting Entry Operations for a Medium Intensity Regional Conflict

Scenario 5 – Support to an Amphibious Ready Group (ARG) conducting entry operations for a major regional conflict involving a Coalition Task Force

The ARG is **based on two RAN LHDs and a RAN LSD** (TBC). The ARG should be capable of conducting coordinated air and surface STOM assaults of up to four Infantry/Cavalry/ Tank Combat Teams, plus an Offensive Support Battery, and a Battle Group Tactical Headquarters. The LF is a medium-weight Battle Group of up to 2,200 personnel with associated stores and equipment, supported by engineers, armed reconnaissance helicopters, and heavy/medium lift helicopters.

This regional scenario would involve the **ARG securing one of several SPODs and APODs for follow on forces provided by the US and major international partners,** in the manner of 3 CDO BDE RM in the Falkland Islands in 1982 and 15th/26th MEUs in seizing APODs in Afghanistan in 2001. Coalition engineers, such as NCF Seabees and 6 ESR, would be required to rapidly follow the ARG engineers in order to provide Force Level Engineering that is outside the capabilities of the ARG engineers.

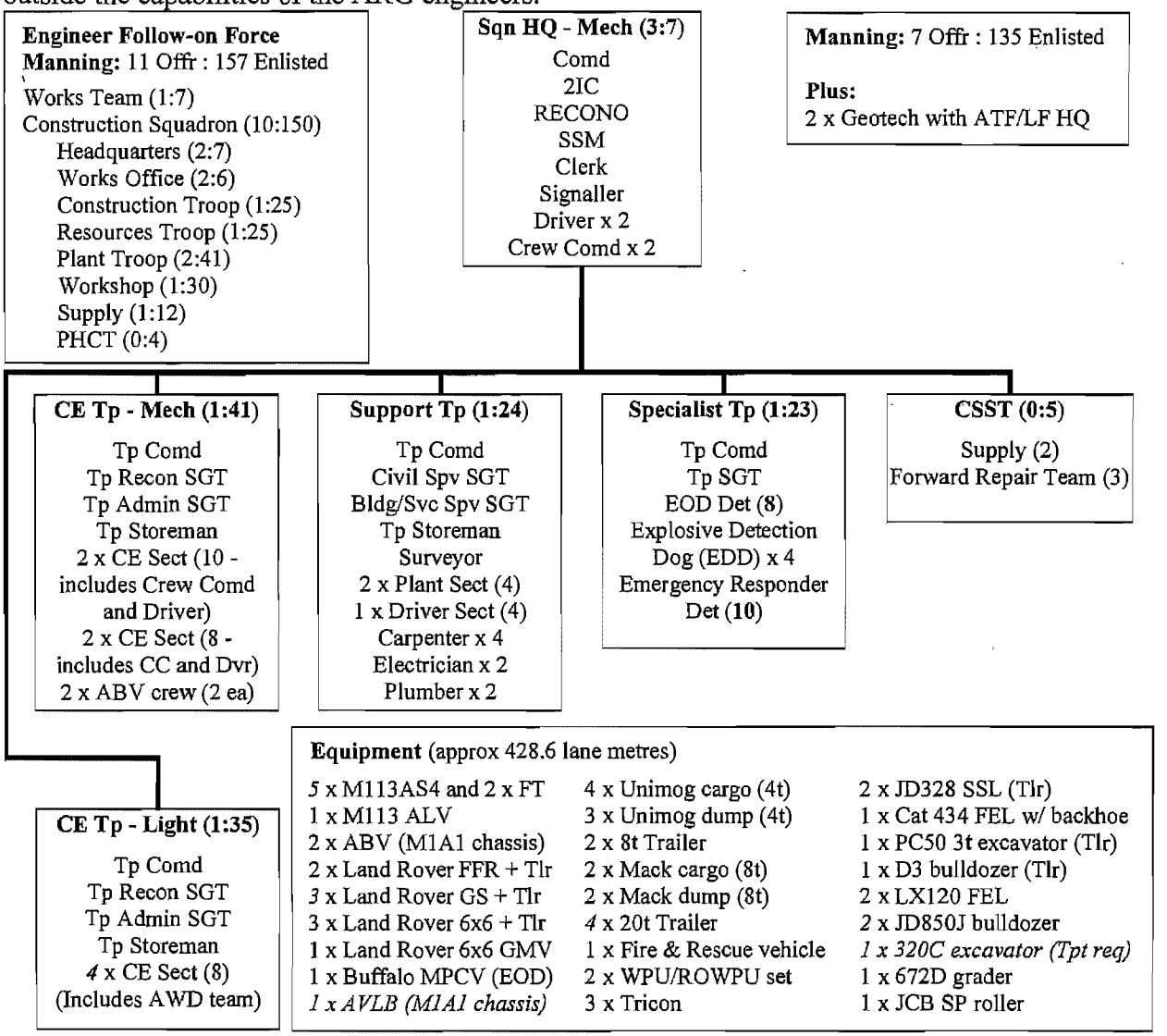

Figure 15. Proposed Engineer Support to an ARG Conducting Entry Operations for Major Regional Conflict Involving a Coalition Task Force

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